REPORT

ON

QUAKER COMFREY

(SYMPHYTUM PEREGRINUM)

Number One

THE 1954 RESEARCH RESULTS

By

LAWRENCE D. HILLS

Published 1955

By

THE HENRY DOUBLEDAY RESEARCH ASSOCIATION

BOCKING, BRAINTREE, ESSEX, ENGLAND

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(All money from the sale of this report is to be used for further research by the Research Association.)

QUAKER COMFREY

Quaker Comfrey is the name given to the only stock that is now in the United States and Canada. It is the British Webster Strain, reselected by myself from the plants supplied to Mrs. P. B. Greer from my Southery Trial plots in 1951. It was sent to Messrs. Bodie Seeds of Winnipeg in the spring of 1954 and arrived after an epic battle with Authority on both sides of the Atlantic. It came from land that had been given no artificial fertilizers since 1936, and was certified by the British Ministry of Agriculture as entirely free from any disease (there is only the Comfrey rust, and a rare virus, and neither have ever been found in this strain).

To mark the fresh start that this reselected strain of Symphytum Peregrinum, the first plants of this species to cross the Atlantic, it was christened "Quaker Comfrey" in honour of Henry Doubleday, the Quaker smallholder, who introduced it from Russia in 1870. So far as we know the very latest import from Russia was 1900, and though the name "Russian Comfrey" is used in England, and is so well established that a change would cause confusion, in the U.S.A. and Canada the new name can be regarded as meaning "a good strain of what farmers in this trial are growing".

The crop is unknown in the U.S.S.R., it is a natural hybrid from a collection of Symphytums in the Palace of St. Petersburg, gathered by Mr. Joseph Busch of Hackney, London, Head Gardener to Catherine II ("the Great"), sometime before 1790. It was a Quaker who selected the best variations and gave this crop to the world; he was awarded a Fellowship of the Royal Society (Britain's highest scientific honour) for his work but was too poor to pay the few guineas subscription to this august body, founded by King Charles II. We, therefore, call it "Quaker" Comfrey, and we hope that by the efforts of the farmers of all countries we shall realise the dream of its discoverer — that this crop should feed a peaceful world.

One more point or two for transatlantic readers. In Britain we call "Alfalfa" "Lucerne" (we do not call "gasoline" the right name either), so throughout just correct it in your mind. All the weights in this Report are British tons (2,240 lb.), and any money mentioned is in £ s. d.; a pound is roughly $3. While the Association is glad to correspond with all Quaker Comfrey growers in all countries, its task is Research, it does not sell plants. Neither can we recommend British suppliers direct, because the regulations of your Government not only mean trouble this side beyond all payment or profit for the sender, but your Authorities then fumigate the plants on arrival and kill the lot. So please do not write for them, your Authorities and ours make it impossible. Mr. A. H. A. Lasker and I fought the Quaker Comfrey into Canada, it is now a Canadian plant, and I have much pleasure in recommending you to buy this strain; it is the best we have found yet.

Quaker Comfrey is sold by Messrs. Bodie Seeds, Limited, Winnipeg 2, Canada.

LAWRENCE D. HILLS.

(For time of distribution of Quaker Comfrey see inside back cover)

QUAKER COMFREY REPORT

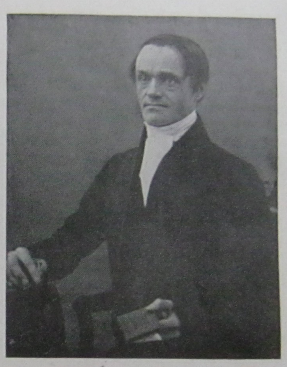
NUMBER ONE

The 1954 Research Results

by

LAWRENCE D. HILLS

(Author of "Russian Comfrey," Faber & Faber 15/-)



Henry Doubleday, of Coggeshall, who introduced this crop in 1870. The Association is named in honour of this Member of the Society of Friends, who sought no profit from his 30 years of research and found none, but whose work and traditions remain our guides.

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The Henry Doubleday Research Association

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This acre of Stephenson Strain Symphytum Peregrinum in its second cutting season, just before a ten ton cut on a Devon Farm, is how a field crop should look.

Fig. 1.

Mr. J. C. Quicke, whose plants are not yet fully established, secured over 2½ times the yield of the Hannah Dairy Research Trial (1944) in 1954, one of the coldest summers on record. It is a perennial like lucerne, but lasting 20 years, and like lucerne, only those who know how to grow it get a good crop.

INTRODUCTION

The reputed yield of Russian Comfrey (Symphytum peregrinum Ledeb., Order Boraginaceae,) when fully established on good land with correct cultivation, is 100 tons an acre. This bulk of foliage is produced in from six to eight cuts according to season, between April and November in Britain, and its high ratio of protein to fibre (3.4% protein to 1.5% fibre, according to Bulletin 48, "Rations for Livestock", H.M. Stationery Office, 4/–, page 128),[1] makes it highly suitable for pigs and poultry apart from other stock. Yet ever since it was introduced from Russia about 1870 by Henry Doubleday, a Quaker smallholder of Coggeshall, Essex, its yield and agricultural value has been the subject of controversy rather than research.

The rediscovery of the methods used by Henry Doubleday (the Association is named in honour of the man who spent the last 30 years of his life in research on the crop) and the farmers of the past to grow the heavy crops reported by the Royal Agricultural Society of England in 1882,[2] has resulted in an increasing modern interest in this neglected plant. It is a perennial, lasting up to 20 years on the same site without deterioration, unsuitable for use in rotations or leys, so its position should always be chosen for convenience in feeding, conservation or composting. This long life, to be compared with that of an orchard rather than a short-lived perennial like lucerne, counteracts the greater cost per acre. Seed is very rarely set and is undesirable, for reasons discussed fully in a later section of this booklet, so it must, at our present state of knowledge, be planted from rooted offsets, which reach full production in the third and fourth year after planting.

The present series of trials, which it is proposed to continue through 1955 and 1956 to average weather conditions in Britain and overseas, is designed to establish the yield of the crop on farms where it is grown well by those who feed it successfully to stock, and to secure information on cultivation, conservation and feeding as practised today. At the same time, every endeavour is being made to check the results of the past, to test whether these are economic at present labour costs, and to discover how far the use of new agricultural developments can overcome the problems that caused the crop to fall out of favour between 1900 and 1916.

Nine farmers in Great Britain and Eire have co-operated, and so have an amateur gardener, a market gardener, a Young Farmers' Club and a Municipality; three of these are growing the crop as a source of compost material. A further five growers in countries overseas are also co-operating and their number will be increased in subsequent years. Their figures in the Overseas Section are incomplete, not only because of the seasonal differences in Southern Latitudes, but because it has been found in course of our work that, in subtropical and tropical climates, the cutting season is greatly protracted, the yield greater, and high protein fodder in dry seasons of even more economic value than in Britain.

It has been confirmed, from sources supplied by the Food and Agricultural Organization of the United Nations, that no research on Russian Comfrey (which is not cultivated in the U.S.S.R.) has been carried out overseas, other than on the Continent and in the U.S.A. in 1899, in all cases with the less productive species, Symphytum asperum Lebech., which was introduced to agriculture in 1810 by James Grant,[3] but replaced in Britain by the more desirable S. peregrinum. These overseas plots are therefore of great interest because both the species and growing methods are new to the countries concerned. We have no knowledge of the eventual yield in 12 months of fully established plants in Africa, because none have been grown there for longer than two years. Official opinion and advice overseas is, it appears, based on quotation from recent accounts from England, and this has been found to have no reference to the performance of the crop under different climatic conditions.

This report has only been made possible by the enthusiastic and entirely unpaid help in a season of great agricultural difficulty when any extra work in Britain has been a burden to every farmer, by the following Comfrey growers: Miss K. Arundel of Cardigan, Wales; Col. P. Bence-Jones of Co. Cork, Eire; Mr. J. Wallace Boss of Gordon's Bay, Union of South Africa; Mr. H. Dunley-Owen of Salisbury, Southern Rhodesia; Mrs. G. Furness of Burnham, Somerset; Mrs. P. B. Greer of Layer-de-la-Haye, Essex; Mr. M. Jones and the Holbrook Young Farmers' Club, near Ipswich, Suffolk; Mr. J. King of Waimate, New Zealand; Mr. J. Lackenby of Middlesbrough, Yorks; Mr. I. G. Macdonald of

1 *It has been confirmed by Professor H. E. Woodhead, M.A., Ph.D., D.Sc., author of the Ministry of Agriculture Bulletin, that the Analysis of "Comfrey (Russian)" is among the By-products next to Cottonseed Bran by a misprint. The sample has been traced to the farm of origin and the crop identified.*

2 *Journal of the R.A.S.E., Vol. 18, 1882.*

3 *A modern botanical account of the Symphytums will be found in "Flora of the British Isles" by A. R. Clapham, T. G. Tutin and E. F. Warburg (Cambridge University Press, 1952, 30/-). Symphytum asperum was formerly S. asperrimum Donn and it is illustrated in colour and described in Curtis's Botanical Magazine, Plate 929. S. peregrinum is illustrated and described 73 years later (Plate 6466).*

Goudhurst, Kent; Lady Betty Markham of Nairobi, Kenya; Mr. J. C. Quicke of Exeter, Devon; Mrs. M. Ridsdale of Salisbury, Southern Rhodesia; Mr. S. H. Statham of Pinner, Middlesex; Mr. E. V. Stephenson of Little Weighton, Yorks; Mr. F. Newman Turner of Shaftesbury, Dorset; Mr. P. Weir of Alton, Hants; and Mr. J. C. Wylie of Dumfries, Scotland.

In his capacity as editor of "The Farmer", Mr. F. Newman Turner has been of the greatest assistance not only in publishing the results of the trial as they came in as a series of articles and in supplying without charge the blocks of all the illustrations in this report, but for the exhibits at the Royal Agricultural Show, Windsor, and the Dairy Show at Olympia, concerning the trial.

Help is gratefully acknowledged from Messrs. Unilevers, who have carried out the analysis of many hay samples without charge, also for the nutritional tests that are still in progress, and to Messrs. Silorator Ltd. for information on silage and the folding of bullocks on a first-year plot behind an electric fence. The thanks of all Comfrey growers, both today and in the future, are due to Mr. A. H. A. Lasker, President of Messrs. Bodie Seeds Ltd. of Winnipeg, Canada, for the financial support that made both the trial and this publication possible, and to the many readers of my book, "Russian Comfrey" (Faber & Faber, 15/–), who sent donations so that the work, which I began in 1950, could go on.

It should be noticed that the addresses of the growers are abbreviated both here and in the body of the Report. This is purely to avoid adding the answering of hundreds of letters and being burdened by unexpected visitors to the labours so willingly undertaken by the working farmers in the trial. All correspondence should be addressed to the Association, and we will be very glad to arrange visits to Comfrey plots during the growing season in Britain and overseas. While we are glad to put enquirers in touch with approved suppliers, especially those willing to export, if no local source can provide offsets more cheaply than by air freight or cool storage by sea, we are not in any way concerned with selling plants. The need of this crop is not publicity but research, and it has suffered greatly in the past from those who seek only immediate profit.

It is earnestly suggested that all who are officially concerned with fodder crops should suspend judgment on yield figures, so much greater than those usually quoted by them, until they have seen at least one plot growing on a farm in the trial. For the past 145 years since James Grant, botanic gardens and research stations have been planting small plots of one Comfrey or another[4] as curiosities or small-scale trials whose cultivation has differed greatly from those who grow the crop for stock feed. These plots have, if anything, proved a handicap to knowledge.

Very much more can be learned by a series of visits to a farm where Comfrey is grown to cut and weigh an established area of greater size, for it is the preoccupation with "disproving claims" that has prevented serious work on outstanding problems. Though an acre of plants as good as Fig. 7, in the middle of this Report, would yeild more than twenty tons of fodder, exceeding the commonly quoted 12 tons for a whole season[5] in a single cut, the full yield is made up of repeated cuts and only by following a field through the year can its production be assessed.

The agricultural research worker will be sceptical of the accuracy of our yield figures, which are still above those of the Hannah Dairy Research Institute, even if no fraction smaller than a ton is considered. Those who have, as I have, searched out and read every reference to the crop in agricultural literature back to 1810 will appreciate the detail as conclusive evidence that something has been definitely cut and weighed, not estimated by eye or quoted from the past. Apart from the yield of the Rev. Henry More of Carnew Castle, Ireland, in 1835 for Symphytum asperum (83 tons total, a record for this species), which was still being quoted in 1900,[6] the only others of the same detail are those for 1876 on Henry Doubleday's smallholding, quoted in "Forage Crops" by Thomas Christy (1877).

Though there is abundant evidence to justify the smallholder, the specialist pig or poultry farmer, or those concerned with racehorses, hunters, riding school hacks or show jumpers in planting Comfrey with confidence, farm scale plots should still be regarded as experimental. Before the five-, ten- and twenty-acre fields that the possibilities of commercial drying for sale to compounders as a low-cost high-protein stock feed ingredient would suggest, are planted, there is need for further research.

This is an experimental crop and as this Report is on the first large-scale experimental work on it, and then only concerns the first year of that work, those who wish to exploit the commercial possibilities on a larger scale are advised to get in touch with the Association for the very latest information that refers to their country and climate.

The limitations of this Report will be realised by qualified fodder crop research workers; I am fully aware of them myself, but many have been imposed by the small size of the sum available for research, compared with those freely provided for commercial products or military developments. This Report is a full and accurate account of the knowledge we have gained for approximately £150, spent almost entirely on commercial analysis, plus almost unlimited trouble on behalf of 18 farmers and amateur gardeners who paid even their own postages. It will have served its purpose if it merely shows that there is sufficient evidence to justify more serious and far more accurate work by the Research Stations and Farm Institutes of the world.

1. METHODS OF CULTIVATION

All plots in this trial are grown by the same methods, the manurial treatments vary, and so does the soil, but the same general principles are used. Variations in spacing may prove desirable (Lady Markham in Kenya considers 5 ft. apart each way instead of the 3 ft. each way used in Britain would be an advantage, with swifter growth, in her climate), and tests over five years would be needed to give a clear answer which would be different for every country in all probability. The system described in this section is that by which our ancestors between 1870 and 1900 grew their 100-ton-an-acre crops, and the modern farmer cannot do better than follow them, until and unless long-term research can reveal improvements in terms of yield or economic advantage. Research Stations would therefore be advised to make any trials they may undertake by the same methods, for the testing of, say, new varieties of potato on the flat and with grass between rows and plants would produce an entirely misleading result however carefully it were recorded and replicated, when compared with farm crops under normal cultivations.

The usual site on the modern farm is the odd bit of land, often previously the home of nettles and rubbish, which is near the buildings, both for feeding and easy cartage of manure, and which can be taken out of the normal rotation without difficulty. As there is no reploughing or seeding once the crop is in, awkward access or working for machinery would seem of little importance, but as for the first three years the plants will need hoeing, and cutting by normal tractor mower and swathe board or a Silorator if possible, the advantage of mechanisation should be considered. For small ¼- or 1-acre plots to supply a daily ration for pigs, poultry, horses or goats, access for a motor hoe or a rotary cultivator, like a Clifford, is sufficient.

The position should be as open as possible to give maximum sun for, though the oldest plot in Britain, Mr. E. V. Stephenson's at Little Weighton, has just completed its sixteenth cutting season on a tree-shaded ¼ acre of poor and very stony soil, the more sun the bigger the crop. At least 4 ft. root run above bedrock is needed, thin soils over chalk or limestone are unsuitable, and as with every other crop, the better the land and manurial treatment, the heavier the yield, though a low yield on a poor soil may beat other forage crops in the same situation. It will take moderate winter waterlogging though not sour land from poor drainage all the year; a frost hole is suitable (apart from any difficulty for mechanised cutting and hauling) but a peat bog is not. The plant is reputed to be drought immune because its roots go down 10 ft. or more and tap subsoil water (and minerals) and, in the opinion of experienced growers, the heavy yield in a year of parched pastures makes a very valuable standby feed on any dairy herd. It is hoped to check this statement, but 1954 gave no opportunity to the Association to confirm or deny it.

The land should be prepared as for a good root crop, but with care in cultivations to remove as many perennial weeds as possible. It can, as an example, follow a clearing crop like potatoes, with autumn ploughing and dunging, spring liming (minimum pH 6.2, 7.0 is ideal), cultivated in to give a kill of winter-germinated weeds, and March or April planting. September planting gives a heavier first-year yield and, before the plants begin to grow again, seedlings can be killed by harrowing, Calcium cyanamide or T.V.O. as used for weeding carrots in the Cambridge and Norfolk Fen country. Sulphuric acid should not be used and, though an established crop will stand both 2-4-D and M.C.P.A. (with a fall in yield), these selective weed-killers do not destroy the worst weed of all in Comfrey, which is grass. On a basis of one experiment it has been shown that Comfrey can be weeded with Tecane, which destroys even Couch (Arrhenatherum elatius, False Oat, also Twitch or Scutch), but further work is needed before this can solve the weeding problem as cheaply as that of wheat. On this evidence there is nothing against clearing an impossibly weedy place with a killer effective against quick thorn, briar and brambles.

The best planting method is to use a cabbage marker set to 3 ft. spacing and run both ways across the field. Plant the offsets with an iron-shod dibber at the intersections of the lines; they consist of three or four inches of brown root with a growing point and are about as easy to plant as cabbages. A Robot could be used, and the

4 *In 1900 Symphytum tuberosum Linn. was tested as "Comfrey" in Scotland, S. officinale Linn. the herbalists Comfrey in Holland in 1936, and again and again S. asperum has been tried in place of S. peregrinum.*

5 *Reported in an article by William Holmes in "Agriculture" for February 1946.*

6 *By William Freum in "The Complete Grazier", less well known than his still famous "Elements of Agriculture".*

same principle of not burying the growing point applies. They have been successfully planted along a furrow, but this needs a good ploughman and, as the second furrow falls, some roots may slip out of place. On a small scale, a garden line and yard-stick are used.

The object of this care is so that they can be cross-blocked or hoed both ways by power or horse tools. For the first two years it is important to keep down grass and weeds; in the third year the problem is less; and a good five-year-old, meeting in the rows before cuts, needs spring and autumn cleaning only.

It has frequently been suggested that closer spacing would reduce weeding (the nurseryman with a foot between rows and six inches between plants hoes once in late spring only), but never by those with an established plot; the 3 ft. each way spacing looks wide before the plants become discs of growing points after every cut, a foot or more in diameter. Experiments to discover if there is a grass suppressing legume suitable for undersowing will be carried out at the Bocking Trial Grounds of the Association. The spacing can be varied either way to avoid tool bar resetting on a holding where other distances are standard, but, within reason, first-year plants give a small crop and are no more a guide to the space that will be needed in future than the first-year growth of an orchard of top fruit.

The first cut, with March planting and a normal spring, will be about the end of May. If the plants went in as late as the end of April an early cut will be even more necessary, as so many plants will run to stem and flower which weakens them at the start. It is best to do this with a grass mower, set to cut two inches from ground level, or any smaller appliance. This cut can be gathered up and fed, but it will be small and hardly worth it on a farm scale.

The most common commercial cutting system is to take off a daily ration from roughly one-thirtieth of the plot; by the time it is crossed the first to be cut are ready for the next. This is varied according to weather and needs, the increase of production with warmer weather fits nicely with the increasing appetites of pigs, up to 10–12 lb. fresh a day, for baconers coming on to finish. For horses there is considerable latitude; they like it stemmy, so it is taken between knee deep and waist high, and the number of crossings varies with the year, five or six usually. For pigs and poultry it is cut for leaf, with more frequent crossings, before there are any stems, so individual cuts are smaller but there are more of them. Those who compost or conserve can cut the whole plot by mower and pick up with a buck-rake if desired.

Though Symphytum peregrinum can provide its mineral needs by means of the large vertical search area of its roots (they do not spread greatly in a horizontal direction), it requires nitrogen. A neglected crop will pull ahead in spring and in the autumn on the natural nitrogen cycle, and this year's trial has shown that a June or July dressing of a nitrogenous fertiliser is required for a heavy yield, even if nothing is given otherwise but lime in the autumn. Ideally, this should be organic and it can be crude; fresh poultry manure straight off the dropping-boards can be used, pig manure is excellent and sewage sludge also effective. Sulphate of Ammonia is inclined to lock up available calcium; Nitrate of Soda causes complications on heavy land, especially for a crop that stays down twenty years; and Nitro-chalk is the safest if an artificial manure must be used. No research has been done on the optimum dressings of fertilisers by any Research Station, so the grower is advised to continue with the treatment that grew the crops of the 1890's.

On a small scale these methods are exactly the same, with hand labour, shears or a large knife for the amateur poultry keeper replacing the tractor mower on the farm. The three rules for successful Comfrey growing are the same on all sizes of holding and in all countries: "Keep it Clean, Keep it Fed and Keep it Cut."

During 1954 no new discoveries have been made on cultivation other than by Mrs. P. B. Greer, who has found the best method of increase so far for those who wish to increase the planted area after a small plot has done well and the owner has found that the crop suits his farming routine.

In March or April, as soon as the growing points appear and the dormant crowns begin to grow, cut through each main root about 4 in. below the surface with a sharp spade and lift out the whole crown, leaving the main root undisturbed in the ground. Cut up these crowns into offsets with a sharp knife; there appears to be no difference in root-producing power between the bark of the root and the white, cut surface, but each should have a growing point. Large pieces are an asset, they make the best plants quickly in the first year though differences are undetectable afterwards; the limitation is that they should not be too big to go easily with the dibber in exactly the same way as advised for a new planting.

Harrow (or fork and rake) the old plot level. By early June new growing points will have formed, and the later cuts will be those of normal second-year plants. Fig. 8 shows the second cut on plants used for propagation in this way. The advantage is that the whole plot is not reduced to first-year production, the original plants

are kept and the increase is merely at the expense of a rather later start to the cutting season. The total of new plants depends on how well the crop grew the first year, but between fivefold and tenfold can be expected. The cutting of the crowns should be done with sacks to catch the root fragments; these should be tipped in the pig food for eating, or burnt. At this season the smallest portion will grow and, in the wrong place, as an example in arable land, they can be weeds. For the destruction of unwanted, overage or low-grade survivors from the past that have interbred with the Common Comfrey (S. officinale), see the Appendix.

Evidence is accumulating that the best yields and the greatest advantage is on heavy clay, hence the popularity of the crop in Essex in the past; the removal of the problem of snatching a seed bed in difficult weather is one of the assets of the crop. The evidence is conclusive that a poor crop grown badly is far more trouble than a good variety grown well, the higher the yield the easier it is to grow and the greater the profit. This applies to all other crops, though it is rarely suggested that a poor opinion of Russian Comfrey may be due to lack of knowledge and skill in its cultivation.

2. YIELDS IN BRITAIN

All but one of the British plots in the trial are planted with one or other of the two commercial strains of Russian Comfrey, "Webster" and "Stephenson". The exception is a plot that has survived at Ferne Farm, Shaftesbury, Dorset, from the days when this was a racing stable; its range of variation appears to be roughly the same as the other two. (For the genetical reasons for the variation of Comfrey, see the last section of this booklet.) No comparison between the two strains or the odd survivor is possible without replicated trial plots, to rule out differences of soil fertility, and though in two cases plots of several varieties are grown side by side, their differences, though interesting, may be entirely without significance. Testing yield by replicated plots is a long-term task for a Research Station; this trial is restricted to finding answers to questions which can be asked on the farm. The growers of both commercial strains are satisfied with the one they have, there appears little difference in palatability to stock and, though the strain is given in every case, higher or lower yields are influenced too greatly by the chance of which strain happened to be planted first, on the best soil, or experienced the most weather luck.

In no case has a whole acre or half-acre been cut, piled on to tractor trailers and weighed on a weighbridge. This is because all but the four smallest are owned by commercial growers, cutting on a daily rotation, so the whole area is never harvested at once. To cut and weigh the whole area would disorganise the stock feeding for perhaps a month even if the field were level, and to take a quarter-acre out for cutting only, its production available in bulk beyond daily needs would mean financial loss with no funds available for compensation.

In the two cases where the cutting and weighing through the season was undertaken by the County Agricultural Adviser of the N.A.A.S., this official selected a dozen representative plants and cut these every time the field was crossed; the yield was then calculated on a basis of 4,840 plants to the acre, the number at 3 ft. spacing. Though an approach was made in every case to the nearest Farm Institute or N.A.A.S. Headquarters, lack of time and distance prevented more undertaking the task that involves up to eight visits, and quite considerable work with a spring balance. The heaviest individual plant weighed 22½ lb., it grew at Ferne Farm and was weighed by Mr. F. Newman Turner in the presence of myself and Dr. Tj. Bakker, Agricultural Attaché to the Dutch Embassy, who witnessed the second cut. It was, however, too far run to flower to be considered typical and was not included in the records.

In cases where the weighing had to be carried out by the owner of the plot, up to twenty representative individuals were cut, their individual weights sent to the Association and the yield calculated by my father, W. D. Hills, B.Sc. One plot weighs 80 plants a time, Lady Betty Markham's in Kenya, described in the next section. It will be noticed that those weighed by N.A.A.S. officials, either regularly or on single visits, are often heavier in total than those weighed by the farmers themselves. I managed one trip round and visited many of the plots for the first cut, but the limited sum available for the whole programme prevented extensive travelling.

The yields of root or grain crops, even hay or dried grass, are relatively simple to calculate; the quantity sold off a given field, divided by the known acreage, gives a sure test each season on every farm, of value to the farmer as proof of the uses of a variety, a manurial treatment or a cultivation. The yields of fodder crops cut and fed or grazed are less easy to measure; they are usually weighed once or more on Research Stations, and the figures are quoted from book to book. The method used in the trial was the only one possible in the circumstances—it may be 20% too high from unavoidable experimental error —but even with this deduction the yields are still remarkable.

They should be considered in relation to the figure which is the basis of the Ministry

of Agriculture advice on the crop, the yield secured by Mr. W. Holmes, B.Sc., N.D.A., N.D.D., of the Hannah Dairy Research Institute, with a plant stated by him to be S. asperrimum, on half an acre, closely planted in rows 2 ft. apart and with an unmeasured portion undersown with Italian ryegrass. They are: 1943, 9 tons; 1944, 12 tons; 1945, 8 tons.

The season should also be considered; a very cold spring meant only two April cuts out of 13, and these very small, and growth was, in the opinion of the growers, well below normal, a statement that will be tested in future years as the trial continues. Another point is the proportion of established plots—only three are four years or over—for the majority of plantings have been made since the publication of "Russian Comfrey"; these older naturally yielded the most, but the nine second-year plots allow an average to be calculated. We can say that the average yield of these, in 1954, including good land in Devon and Yorkshire and poor on a Welsh hill farm or a school garden in Suffolk, is a little over 25 tons an acre, more than twice the yield of the best year in the official test, and this with plots that have not yet come into full production.

The plots in the trial are described in order of total yield.

No. 1

Mr. F. NEWMAN TURNER, Ferne Farm, Shaftesbury, Dorset

This is a plot of about one-sixth of an acre, rather shaded by trees and buildings, conveniently sited in the past for feeding to brood mares and stallions in the stable yard. It is here used mainly as a diet for sick cattle, for Mr. Newman Turner (author of "Fertility Farming" and "Herdsmanship"—Faber & Faber) runs a clinic for Jerseys as well as his own successful dairy herd. It is mainly used in the treatment of sterility, but the Association is neither qualified nor in a financial position to investigate by scientific research the veterinary uses of Comfrey. We are prepared to present up to 1,000 plants free and give all assistance within our power to any officially recognised body with qualified veterinary surgeons on the staff which will undertake serious experimental work in this field.

The plot is a survival, other corners of the farm contain widely varied hybrids from chance seedings and intercrosses, but this largest patch has no more variations than a normal commercial strain.

	Tons	*Cwt.*	*Lb.*
1st cut, May 12th ...	23	19	76
2nd cut, June 18th ...	8	1	34
3rd cut, August 10th ...	10	10	76
4th cut, October 19th...	8	16	41
5th cut, December 4th	7	0	50
Total for 1954 ...	58	8	53

The heavy cut in May, when the plants were coming up for flower, reduced the yield of the later cuts, and the plot suffered by not receiving its summer dung dressing until August. Mr. Newman Turner took over the farm recently and the plot had been greatly neglected, so the plants are irregularly spaced and must be weeded by hand, a task reduced by the smothering power of the crop. During the first year he pulled it round by mowing repeatedly with a Ferguson and grass mower, letting the cut material lie and the growing points come through the rotting mass which built up humus. The nettles and weeds that strangled it could not stand up to repeated cutting; the Comfrey was increased in vigour. Mowing four times a year and dunging in June appears to be a good method of restoring a neglected Comfrey plot to health, though it is not so effective where grass infests the land.

The first cut was irregular in growth—later cuts levelled off the differences—but the greatest care was taken to include the smallest as well as the best. The 20 plants in the first cut had the following individual weights: 20 lb., 15 lb., 8 lb., 11 lb., 5 lb., 13 lb., 5½ lb., 16 lb., 9 lb., 3½ lb., 18½ lb., 16½ lb., 11 lb., 6½ lb., 5½ lb., 7½ lb., 11½ lb., 18½ lb., 12 lb., 9½ lb. Fractional weights over, but not under, half a pound were neglected, and the average was 11.1 lb. per plant. The Rev. Henry More must have overaged 14 lb. 6 oz. to have secured his 31-ton cut in mid-July, 1836.

It should be noted that all except the December cut exceeded the Hannah Dairy Research Institute's total cut for the 1945 season, and that the total crude protein per acre on the basis of this yield is well over twice that of a 21-ton-an-acre crop of lucerne, which would, however, have produced nearly twice as much crude fibre.

The plot is on heavy clay, in a corner awkward to crop, and Mr. Newman Turner intends to extend it to about half an acre on the present site.

No. 2

Mr. J. LACKENBY, Middlesbrough, Yorks

The area of this plot is about a third of an acre; it is planted on a slope where an old mine working has been filled in; the soil is clay but not particularly rich. It is used entirely for feeding pigs. Mr. Lackenby has a pedigree herd of the Welsh breed and uses the green fodder as a mealsaver, a scour preventer and as a method

of keeping a large litter going ahead towards well-grown level batches (see Section 7 for feeding). Mr. Lackenby is also in the steel industry, and a long spell of overtime in the autumn prevented him cutting his trial plants and weighing until late in the season.

He was, therefore, compelled to confirm the results of the farmers in the 1890's who would leave a late cut on the plants, which has none of the disadvantages of a heavy spring one, for when they knew they would be short of feed. Modern grassland methods that give an early bite, and marrowstem kale, remove some of the incentives from this device of management, though it has possible applications overseas. The aim on the farm is not to make or break records but to have the feed available in bulk from a small area when the stock can use it at a profit. There is a great deal still to be learnt about the most efficient management for each class of stock.

Mr. Lackenby's yield figures are as follows:

	Tons	*Cwt.*	*Lb.*
1st cut, May 15th ...	8	12	98
2nd cut, June 19th ...	12	2	63
3rd cut, August 1st ...	6	9	72
4th cut, October 30th...	26	9	33
Total for 1954 ...	53	14	42

This plot is one of Webster strain planted in the spring of 1952, so this is its third cutting season; its fourth should show an increase in production. The second cut of over 12 tons an acre was witnessed by Mr. J. C. Neilson, N.A.A.S. representative for the North Riding, the first official to cut and weigh a yield exceeding the best year of the Hannah trial, in a single cut. The individual plant weights are as follows: 8 lb., 5 lb., 5½ lb., 5¼ lb., 8½ lb., 7½ lb., 5¼ lb., 8½ lb., 7 lb., 8 lb., 4¾ lb., 3 lb., 2¼ lb., 3 lb., 5 lb., 5½ lb., 3¾ lb., 5¾ lb., 5½ lb., 5½ lb. The average of 5 lb. 9.5 oz. gives the weight, multiplied by 4,840; in weighing the plants on this plot, ¼ lb. fractions above were neglected, new Salter spring balances were supplied, except where an accurate milk recording or other balance was available. Usually the plants are thrust into a previously weighed bag, whose weight is subtracted. On this plot a metal basket weighing 5 lb. is used, and tare deducted; the total reading for the first plant was 13 lb., and so on. In every case witnessing officials or observers were (and are for 1955 in all countries) invited to bring their own spring balances.

No. 3

Mr. S. H. STATHAM, A.R.I.B.A., Pinner, Middlesex

The age of this plot is not known definitely; it is probably about its sixth cutting season and is Webster strain. Thirty-six plants are cut at a weighing and the produce of this smaller plot used for composting. It had little manure and is an example of the production that can be secured in a town garden by the compost maker. Though to those who are concerned with nutrition, animal or human, composting Comfrey appears waste, the potash is considerably higher than that of Bracken at the best stage (see the ash analysis figures in Section 5), and its permanence and production make it of value for this purpose.

It was not possible for any of these cuts to be witnessed. They were weighed carefully by Mr. Statham, an architect by profession, and the greater number of plants increase the likelihood of accuracy in calculating the rate of production in terms of acres.

	Tons	*Cwt.*	*Lb.*
1st cut, May 30th ...	10	14	84
2nd cut, June 26th ...	10	7	34
3rd cut, August 8th ...	11	4	63
4th cut, October 5th ...	8	11	56
5th cut, November 17th	2	6	53
Total for 1954 ...	44	4	66

No. 4

Mr. E. V. STEPHENSON, Little Weighton, Yorks

On this stud farm the Stephenson strain originated. It appears to vary a little more widely than the Webster, but there is as yet no evidence that these variations are significant. The plots with this strain are all in their second cutting season and, therefore, can only be compared with plots of the same age and, spaced as these are on all types of soils, in many counties and with weather variations, no comparison is possible. The crop is fed here to stallions valued at up to 12,000 guineas each, approximately £100,000 worth of brood mares and foals a season, horses in training, a hunter, and to pigs and deep litter and non-intensive poultry. During the war years it was also used for calves, as the main plot was planted in 1938 from stock supplied by the late Mr. Kenneth Crawley of Lockerbie, Dumfriesshire.

The plot in the trial was, however, planted in September 1952, so is in its second cutting season. It is about an eighth of an acre, and is on the site of a filled-in pond on the Middle Piece Farm. It is surrounded with a chestnut fence, and the object of the planting is to allow the daily ration for mares and foals to be tossed over to them; at other seasons it is bagged and carted where required.

The reputed yield for a second-year plot is from 40 to 60 tons an acre and, with this first planting of this age to be recorded

in the trial, the smaller target should be noted.

	Tons	Cwt.	Lb.
1st cut, May 16th ...	12	19	22
2nd cut, June 21st ...	7	0	50
3rd cut, August 3rd ...	6	7	52
4th cut, September 15th	5	12	21
5th cut, October 21st...	2	3	24
Total for 1954 ...	34	2	57

The type of weather experienced through the spring and summer of 1954 should be considered in relation to the yield. The individual plant weights, cut by Mr. Stephenson and myself on September 15th, show the type of weight to be expected from second-year plants, 43 days' growth in a poor season: 3 lb., 3 lb., 1 lb., 2 lb., 3 lb., 3 lb., 1 lb., 4½ lb., 3 lb., 2 lb., 1 lb., 4 lb., 4 lb., 4 lb., 3½ lb., 2½ lb., 2 lb., 2 lb., 2 lb., 1½ lb. Average 2 lb. 9.6 oz.

The last cut was not weighed, but estimated (deliberately low), because this was destroyed. The bullocks that graze the field, after the mares are off it, broke through the fence and ate the whole plot flat. This is the third case reported this year. The first was on a farm near Wadebridge, Cornwall, with a good quarter-acre coming up for the third season, which was grazed and trampled so badly just before the first cut that it had to be left out of the trial until 1955. The second was one of Mrs. P. B. Greer's plots, not her trial half-acre. This may merely be evidence that stolen fodder is always more palatable to cattle, but it should be considered in view of the often quoted opinion that "no stock will eat Comfrey if they can get anything better". It is also possible that those who grow the crop well produce more palatable feed than those with less skill in its cultivation.

No. 5

Mr. J. C. QUICKE, Exeter, Devon

This acre of Stephenson strain, in its second cutting season, is one of the finest in the trial. It is on good red Devon loam, an open strip convenient for mechanised cultivation, next to a pig pasture into which production can be dumped. It is important to consider the main problem of the successful Comfrey grower, the handling of heavy daily cuts where it is fed green, and sites should always be selected with this point in view.

The cuts are as follows:

	Tons	Cwt.	Lb.
1st cut, May 13th ...	10	3	22
2nd cut, July 2nd ...	14	6	36
3rd cut, August 25th ...	6	6	45
Total for 1954 ...	30	19	103

No witnessing was possible, but a representative of the National Institute of Agricultural Botany visited the plot just before the second cut. The frontispiece shows a portion of the field before the first cut, in which the weights of the trial plants (a random row across the middle, neglecting guard plants at the ends, as these may differ widely either way) were: 4 lb., 3¼ lb., 4 lb., 4 lb., 5 lb., 6¾ lb., 5 lb., 8 lb., 4 lb., 4 lb., 6 lb., 5 lb., 6 lb., 6 lb., 6¼ lb., 5½ lb., 4 lb., 3 lb., 2 lb., 2¼ lb.

Unfortunately, the weather beat the crop, not so much by its effect on the growth, which should have exceeded that of the same strain in Yorkshire, but by enforced neglect. On a large modern farm with a small modern labour force, the fiddling jobs like cutting and weighing, as distinct from a daily cut by the pigman who is pressed to get back to jobs that may save a weather endangered profit, get missed. This is one of the handicaps of on-the-farm experiments.

The plot did not receive dung in June or July, it had nothing all the year, and the August cut shows the fall that can be expected where manure is missed. Mr Quicke has allowed the final cut to die down unweighed, repeating another device of the past. In his first season he allowed several rows to die down uncut, and found that their early production was improved. This is recommended by some authorities of the late nineteenth century where spring feed was of the greatest importance. The third- and fourth-year yields on the plot in 1955 and 1956 should be of great interest.

No. 6

Mrs. P. B. GREER, Layer-de-la-Haye, Essex

This half-acre of Webster strain in its second season on Essex clay is the first of the two in the trial to be weighed at every cut by the A.E.C. The original letters, in which Mr. H. J. Mason, Assistant Advisory Officer from the Colchester headquarters, informed me of the weight of each cut, are available for inspection (with all records and the original Analysis Certificates which relate to Section 5). Its yield should, therefore, be regarded by those officially concerned with Agricultural Research as being the most authoritative of any in this trial. It is hoped that the plot can be followed through the next two years until it is at full production, by the same branch of the National Agricultural Advisory Service.

The figures are as follows:

	Tons	Cwt.	Lb.
1st cut, April 22nd ...	2	0	0
2nd cut, May 28th ...	8	18	30
3rd cut, June 19th ...	5	2	71
4th cut, July 26th ...	4	1	19
5th cut, September 28th	6	18	89
6th cut, October 22nd...	1	13	22
Total for 1954 ...	28	14	7

It should be noted that this is well over twice the yield of 12 tons an acre of the only officially published British result.

Mrs. P. B. Greer, who was formerly Principal of Holmes Chapel Agricultural College (during the 1914-1918 war), is one of the keenest experimenters in the trial. Her remarkable hay results and her feeding experiences are recorded in the appropriate sections. It is possible that her discovery of the possibility of grazing with geese may have wider application now that electric fencing can be used to fold these birds. She is an organic farmer like Mr. Newman Turner and most others in the trial, and the land on which the crop is growing has had no artificial fertilisers since 1936. It has received compost and, in the opinion of the A.E.C. Assistant Advisory Officer, is in a high state of fertility.

No. 7

Mrs. G. FURNESS, Burnham-on-Sea, Somerset

This is the smallest plot in the trial; it consists of 18 Stephenson strain plants grown on a market garden purely as an experiment to produce compost material. Each cut was witnessed; the County Horticultural Adviser could not spare the time, so neighbours of the owner, mainly retired officers of the Navy or Army, carried out the weighing.

The yield was as follows:

	Tons	Cwt.	Lb.
1st cut, May 22nd ...	8	7	23
2nd cut, July 2nd ...	8	13	15
3rd cut, August 5th ...	2	3	24
4th cut, September 28th	4	1	3
5th cut, November 12th	1	18	39
Total for 1954 ...	25	2	104

The plot was planted in the autumn of 1952 and, though it had the advantage of a rather milder climate than Yorkshire, it is not in an open situation. It might be supposed that a small plot would give a yield too high to be fairly compared with farm-scale crops, but in this trial it has been found that the larger areas are the most productive.

No. 8

Mr. P. WEIR, Alton, Hampshire

Mr. Weir is the final winner in a duel with another young and enterprising farmer, which has aroused an entirely unscientific interest among readers of the reports in "The Farmer", and they have "raced" neck-and-neck like two motor-cyclists in the T.T. lying 164th and 165th alternately for lap after lap.

His plot is a second cutting season, Webster strain, on a poor clay that is low in lime. It is perhaps the most fully recorded of the plots and, though Reading University could not manage to fit in even a single visit to take and weigh a cut, as they hoped at the beginning of the season, every cut has been witnessed by someone, if only another farmer or a neighbour. A N.A.A.S. analysis, taken by Mr. D. J. Goodchild on April 28th, 1954 (Sample No. HPA 3528), showed a pH of 5.2, Phosphate very low, Potash fair, Calcium carbonate nil, organic matter fair. The holding is marginal land, semi-derelict woodland in process of clearing by pigs, and these are the main stock, apart from poultry. The plot consists of 128 plants conveniently sited for feeding green, and other plots have been established behind fencing for convenience of rationing.

The growing points of the plants were just visible above ground on March 21st, and the first weeding was given on March 22nd. On April 14th, 3 cwt. of lime was applied to the one-twentieth acre plot. Dull, cold, dry weather continued until May, when the first rain fell for 30 days. Sixteen plants, spaced in fours so that they gave a fair sample of size and differences due to soil variation, were cut each time; the balance of the plot, including guard plants, was cut in accordance with the needs of the stock.

	Tons	Cwt.	Lb.
1st cut, April 15th ...	1	2	16
2nd cut, May 14th ...	3	5	40
3rd cut, June 11th ...	3	11	64
4th cut, July 22nd ...	5	8	4
5th cut, August 30th ...	6	4	57
6th cut, October 7th ...	2	19	47
7th cut, November 14th		4	5
Total for 1954 ...	22	14	106

The plot was also weeded on May 26th, July 10th and August 19th, but the main factor that enabled this plot on very poor soil to beat a plot of the same age and strain on better soil in Kent by just over a ton, was the direct mulch of poultry manure applied on June 19th. The summer was dull and cold, with no reasonable growing weather and (in that area) little rainfall until harvest time. Mr. Weir had a very good yield in the autumn of 1953 with first-year plants and considers that the poor October and November cuts were due to the coldness of the soil.

It should be noted that though this plant came from Russia first in 1870, it is a hybrid of garden origin (the gardens of the Palace of St. Petersburg, which became Leningrad 49 years later) and, though it will endure cold, it has never been cultivated as a farm crop in the U.S.S.R., perhaps because heavy yields become possible only in milder climates. This possibility is supported by the next section.

No. 9

Mr. I. G. MACDONALD, Goudhurst, Kent

Mr. Macdonald is a hop farmer who also grows strawberries and runs a herd of Essex pigs, for which he grows Comfrey. His plot in the trial is second cutting season Webster strain, supplied originally from my own trial plots at Southery in 1951, but he has divided up his plants and now has about an acre in several portions of first cutting season new planted stuff. The yield figures for the trial portion are as follows:

	Tons	*Cwt.*	*Lb.*
1st cut, May 10th ...	3	4	92
2nd cut, June 12th ...	4	6	48
3rd cut, July 11th ...	3	19	11
4th cut, August 10th ...	3	11	36
5th cut, October 8th ...	5	4	59
6th cut, November 25th		14	34
Total for 1954 ...	22	0	56

Both this plot and Mr. Weir's had the same weather and were the same strain, planted for the same period. The difference between them is very small, but though no soil test has been done on Mr. Macdonald's plot, it is of higher fertility by normal farm estimating, a Kentish rather than a Hampshire clay, part of a portion of ground formerly used for raising hop setts (hop plants for replacements). The difference that gave a lead of half a ton to worse land was probably due to the manure, the low yield of both perhaps to shocking weather.

Mr. Macdonald has been experimenting with drying Comfrey hay in his oast houses, which are only in use for a short period each year, but have to be kept in repair and have their overheads carried by the hops. If it proved economic to dry Comfrey in the oast houses at off seasons this would have provided a useful sideline for Kent and Herefordshire farmers. They are, however, designed to dry hops, the green flowers of this plant which pile on the coarse netting or "lewin" over the wooden slat floor of the oast with plenty of air-spaces. Their moisture content is lower and the price per dried ton far higher than that competitive with grass meal at which Comfrey meal must be sold if it is made commercially.

Two batches were done, one of 1½ cwt. dry, sent to Messrs. British Oil & Cake Mills (Unilevers) for nutritional tests, 10 lb. sent to a clinic in Canada, and 74 lb. to Messrs. Rutin Products, both for trial under medical supervision. The cost of warming up and running until the fresh Comfrey, about 88% moisture, was dried to 10%, was about £10 in anthracite on each occasion, utterly uneconomic.

Mr. Macdonald has made hay like this in other years, to give himself a reserve as a scour cure and feed for when the crop is dormant, merely by using the suck of the cowls and the fans, but this year the problem was cold and humidity, cowl or fan could only suck moisture-laden air through the crop. Putting up a batch in sunny weather and leaving it to dry slowly over a fortnight between cuts before fetching it down may well be economic, but the height of the oast floor and the carrying up ladders or hoisting makes it unlikely that these traditional Kentish farm appliances, well designed for hop drying in the Middle Ages, are going to be an answer. Like almost everything we have tried this year, no one knew the answer, and, even though this is in the negative, Mr. Macdonald is the first man in history to make the attempt.

No. 10

Colonel P. BENCE-JONES, Co. Cork, Eire

On this farm, Russian Comfrey is used for calves, pigs and poultry, and three separate plots are cut on a daily rotation to provide the ration, as on the other sites. The plot of second cutting season Stephenson strain is in a poor corner, rather shaded, the original planting on which Col. Bence-Jones tried if it was going to suit him; 180 remained unsplit, the balance were divided and planted on better land in the open. The narrow difference between their yield and that of the better-established older plants is a measure of the advantage of field planting, on about half an acre.

In addition, he is testing a second strain, which is, so far as we know, the original introduction of Henry Doubleday. It very closely resembles Plate 6466 of Curtis's Botanical Magazine; the flowers are at first pale blue and they turn pink later, and its production is about as good as a modern strain so far as can be judged. A stock of this variety will, with other variations, be tested at the Bocking Trial Grounds of the Association. It was imported about 1880, within the memory of the oldest inhabitant at least as being newly planted. In 1888 the field was converted into a cricket pitch and arable land, and, though the land is now under potatoes, Comfrey plants still grow in the hedgerows and ditches. As Symphytum officinale is not found in the district, it is possible that some may be reasonably pure, and both the progress of the quarter-acre now replanted and those tested in England will be of interest to all Comfrey growers.

The yields of the plots are as follows. It should be noted that they do not all come off on the same day; the weighings are done when the trial plants are reached at each crossing.

STEPHENSON STRAIN—2ND YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, April 16th ...	2	13	2
2nd cut, May 19th ...	3	14	0
3rd cut, June 19th ...	3	15	70
4th cut, August 5th ...	2	14	2
5th cut, September 20th	4	17	26
6th cut, November 3rd	1	12	46
Total for 1954 ...	19	6	34

STEPHENSON STRAIN—1ST CUTTING YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, April 28th ...	3	11	52
2nd cut, May 31st ...	2	19	85
3rd cut, July 20th ...	1	10	28
4th cut, August 20th ...	3	9	16
5th cut, October 11th...	4	6	48
6th cut, November 8th		17	32
Total for 1954 ...	16	14	37

HENRY DOUBLEDAY SURVIVAL STRAIN—1ST CUTTING YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, May 3rd ...	3	6	30
2nd cut, June 4th ...	3	14	93
3rd cut, July 6th ...	1	5	104
4th cut, August 20th ...	3	9	16
5th cut, October 11th...	4	6	48
6th cut, November 8th		15	14
Total for 1954 ...	16	17	81

It will be seen that there is little difference on yield between the first-year plantings of the two strains; experimental error or slightly better soil, apart from pure chance, would account for it, even discounting the most important consideration. This is the variation among first-year plantings from the size of root and its condition on arrival; plants dug free from a hedge may be larger than those divided from a farm plot or supplied commercially. For this reason no first-year planting in Britain, other than this plot which was included because of the great interest of the rediscovery of Doubleday plants, are in the trial. In the second year they have time to cancel out any differences. Soil and manure are more important than a slightly smaller plant to start with.

Col. Bence-Jones, who runs a large mechanised farm, has devised a variation on normal cultivation. Prepare land with lime, manure and fertilise as for potatoes. Ridge as for potatoes, with 26 in. between ridges. Stretch a line across the middle of the field at right angles to the ridges and plant a Comfrey offset, by just poking it upright into the loose earth in the bottom of every alternate furrow. Move the line 26 in. and repeat, usually done with two lines working in both directions from the middle. Then pull down the ridges with an ordinary tractor draw hoe, and finally roll with a roller behind the same tractor.

The object of the spacing is to allow a 36-in. width for hoeing in both directions with the normal row crop equipment on this farm. The 26 in. between plants and diagonal spacing will cancel out as the plants grow; the importance of inches either way is not so great as that of keeping the weeds down the first year. Col. Bence-Jones considers that, apart from the cost of the plants, first year costs are about the same as potatoes, second year less than any root crop.

No. 11

Mr. J. C. WYLIE, B.Sc., A.M.I.C.E., County Engineer, Dumfries

The plot in the trial is in its third cutting season; Webster strain supplied from my Southery Trial plots. It is sited on very poor soil, mainly ashes plus thin loam on top of gravel, at the Barony composting plant owned by the Dumfriesshire Corporation. A second plot of second year Stephenson strain on better land at the Kirkconnel composting plant was producing 5 lb. and 6 lb. plants at the first weighing, but this was not tested because its great distance prevented the County Horticultural Adviser from cutting and weighing, and the Public Analyst for the County of Dumfries from carrying out fresh weight analysis. These are far more difficult to secure than of dried hay, because wilting reduces the moisture and, obviously, fresh Comfrey sent by post will not only heat, its composition will be a long way lower in moisture than the crop as fed, and its analysis misleading.

Neither plot received sewage sludge; the only manuring was with the municipal compost produced and sold by the Dumfriesshire County Council. Compost with a carbon-nitrogen ratio of 10—1, as used by gardeners and farmers, appears to be too low in nitrogen for the swift growth speed of Comfrey, which can take its nitrogen, the key element for leaf production, very crude and fast. It is hoped to carry out experiments with crude sludge at Bocking, for, near a sewage works with a sludge disposal problem, heavy dressings might be highly economic.

This plot, like all the others, endured a dull, cold summer, and its late Autumn production was reduced by early frosts.

Yield figures are:

	Tons	*Cwt.*	*Lb.*
1st cut, May 17th ...	5	0	93
2nd cut, June 26th ...	4	13	0
3rd cut, August 20th ...	4	16	11
4th cut, October 11th...	1	11	6
Total for 1954 ...	16	0	110

It is hoped next year to include what will then be third season Stephenson strain

in the trial, for the Scottish climate appears to make less difference than soil. Mr. J. W. Hobbs has three acres at Fort William, used for silage; there is a plant thriving at Castlebay on the Isle of Barra, Outer Hebrides, and a small area on Mull used for goats and sheep, all of which are sufficiently productive to satisfy their owners.

No. 12

Miss K. ARUNDEL, Cardigan, Wales

This is a small plot of 40 second cutting season Stephenson strain planted to test the possibilities of the crop on poor soil on a Welsh hill farm. It is used for feeding calves and as pig and poultry green food on deep litter. The soil was acutely short of lime, a dressing was given in the spring, and some poultry manure in August. The main problem of this plot has been, as with all the others, cold and wet. Miss Arundel is to be congratulated not only on her weighings of 20 plants a cut, but carrying out rack drying in the open under her conditions.

Her cuts were as follows:

	Tons	*Cwt.*	*Lb.*
1st cut, May 25th ...	5	5	99
2nd cut, June 24th ...	3	10	34
3rd cut, August 14th ...	3	15	70
4th cut, October 6th ...	1	12	106
Total for 1954 ...	14	3	85

No cuts could be witnessed, but the plot was visited during the season by the Agricultural Officer for the district and one of the staff of Aberystwyth University. As the Scottish trials of Comfrey on hill farms were made with Symphytum tuberosum, a species of no agricultural value, according to Professor K. V. Braid of the West of Scotland Agricultural College who conducted them in 1900, this is the first planting under these conditions. Tests on rather larger areas on the "in bye" land near the farmyard, where both manuring and cultivations would be easy, would give results to be considered in relation to the yields of other crops in the locality and would be of value. The third-year yield of Miss Arundel's plot will be recorded so that the production from fully established plants can be learnt even if only approximately under her conditions

No. 13

THE HOLBROOK JUNIOR YOUNG FARMERS' CLUB, Nr. Ipswich, Suffolk

This plot is entirely unlike any of the others in the trial; it is on poor, sandy soil in the garden of the Holbrook Area School and has had no manure at all, the "no-manure" plot in this experiment. It has been cultivated with enthusiasm by the senior boys from 12–15 who make up the Club, under the leadership of Mr. W. Jones, their schoolmaster. Whatever the value of their work to agricultural knowledge, they have at least learnt some of the fundamental principles of fodder crop research and, by working out in class their yields per acre and taking the analysis figures of their hay as examples, have improved their knowledge of arithmetic.

Four different varieties were grown: Holmes from plants kindly presented by Mr. W. Holmes of the Hannah Dairy Research Institute, Webster and Stephenson "Broad" and Stephenson "Narrow", the last variety being sorted from the normal strain by its narrower leaves and nearer approach to the characteristics of S. officinale. During the first year the plants were merely hoed and kept growing as specimens, some cuts were made, and what was most evident was the greater yield of the Holmes. In the second year the commercial strains pulled ahead; the difference was evidently due to Mr. Holmes's generosity in sending much larger plants than the commercial suppliers.

Each plot numbered 50 plants; those surrounding each were neglected as guard plants and the balance weighed at each cut, made on the same day all through the season. The trial area is an irregular triangle with some shading, as can be seen in Fig. 3, which shows the boys beside their plot some days after a cut.

The entire produce was dried on the roof of the school cycle-shed, put up on the same day and enduring the same weather, and the invention of one of the Young Farmers (to keep it from blowing off by putting up the football goal-nets to hold it on) prevented the wind from mixing the four separate areas. The analysis figures are, therefore, comparable with each other; only one factor varied, the composition of the plant when cut.

Their cuts were:

HOLMES STRAIN—2ND YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, May 5th ...	2	12	105
2nd cut, June 6th ...	3	3	100
3rd cut, July 2nd ...	1	15	94
4th cut, August 10th ...	2	7	30
5th cut, October 13th...	1	7	35
Total for 1954 ...	11	7	23

WEBSTER STRAIN—2ND YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, May 5th ...	3	11	64
2nd cut, June 6th ...	4	3	8
3rd cut, July 2nd ...	2	1	27
4th cut, August 10th ...	2	11	85
5th cut, October 13th...	1	6	18
Total for 1954 ...	13	13	86

STEPHENSON BROAD-LEAVED—2ND YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, May 5th ...	3	16	64
2nd cut, June 6th ...	3	7	28
3rd cut, July 2nd ...	1	12	18
4th cut, August 10th ...	2	15	21
5th cut, October 13th...	1	8	95
Total for 1954 ...	13	0	2

STEPHENSON NARROW—2ND YEAR

	Tons	*Cwt.*	*Lb.*
1st cut, May 5th ...	1	19	18
2nd cut, June 6th ...	5	17	104
3rd cut, July 2nd ...	2	3	24
4th cut, August 10th ...	2	14	0
5th cut, October 13th...	1	16	0
Total for 1954 ...	14	10	36

Within the limits of experimental error, all plots yielded about the same. The Holmes strain was the least productive, but the plants in the guard rows allowed to flower showed little difference in flower colour between the strains; the habit of the plant is very near the two S. peregrinum strains.

The August 10th cut came in the middle of the school holidays, so a volunteer team of older boys went in and cut it unsupervised. No cuts were witnessed other than casually by the headmaster and other members of the staff, and the experiment was regarded as part of the gardening lesson periods. Mr. Jones and his headmaster can have the satisfaction of knowing that their contribution to knowledge of an almost unknown crop will add to the increasing store of accurate information which will be available by the time their pupils have farms of their own.

CONCLUSIONS OF THE BRITISH YIELDS

We know that the fully established plots yield very much more than those in the second year, though a second-season plot on good land will beat third year on poor, and that a first-year plot well grown on the farm will beat second-year stuff with no manure. We also find that the Comfrey on the best land produces the most; half an acre on Essex clay doubles the yield on a Welsh hill farm, as an example. It is also by no means extraordinary that the farmer who produced the highest yield on a second-year plot, on the Yorkshire wolds, was the one who had the longest experience of growing it of any man alive today, and that he was dissatisfied with his yield, blaming the weather for a poor crop, which meant financial loss.

These conclusions are very obvious when applied to any other crop, but this is the first time that they have ever been suggested as applying to Comfrey. Those who have sold it over the past 145 years have quoted the maximum yield figure they can find; those who advise officially quote the lowest, which happens to be the most recent, as though the yield of the famous Broadbalk field at Rothamsted, continuously under wheat with no manure for 100 years, were used to "discredit the claim" of the Turrell brothers of Wainfleet St. Mary, Norfolk, to have grown 3½ tons of grain to the acre. It is readily accepted with other crops, that the man with the high yield used different methods and more suitable land, without any implication that his yield can be secured by those on every farm, whatever its poverty of soil.

The Hannah Dairy Research Institute plot was on land that "was not good but not poor, it had previously produced 16 tons of cabbage an acre and the crop received at least one heavy dressing of dung during its life" (a quotation from a letter from Mr. Holmes). It was planted in 1942 from plants supplied by the late Mr. Kenneth Crawley. In 1945 the first cut was 30 cwt. from the half-acre; on April 20th and on May 30th, 28 cwt. The balance of 2 tons 6 cwt. was made up in the cuts of July 13th and October 6th to make up 8 tons for the year. The most nearly comparable third-year plot is that of Mr. Wylie, which produced double this yield.

It is possible that the experimental error of calculating the yield of an acre by cutting and weighing 20 representative plants, including the worst specimens, may account for the lesser differences between, say, the 1944 12 tons and the 14 tons. 3 cwt. on the Welsh farm, or the Scottish 16 tons, but not for yields over four times as great, and Mr. Newman Turner exceeds by more than seven times the 1945 yield.[7]

We have this year established the fact that the yields commonly quoted in Britain by official advisers have so little reference to those secured by good farmers, that there is a definite case for further research, if only the witnessing of cuts by those officially concerned with fodder crops on the farms where our results were secured. The evidence is at least sufficient to justify seeing the crop grown well, instead of looking up an account of its production when grown badly.

7 *The technique of replicated trial plots is used to rule out variations caused by differences of soil fertility, when several varieties of a crop, or several different manurial or other treatments are being compared. When a single variety is tested, then unreplicated plots on a number of different Research Stations are used to measure its performance under the varied conditions of soil and climate in various parts of the country concerned. The 1954 trial differs only from this type in the fact that many of the commercial fields are larger than the plots hitherto planted on Research Stations in the case of the plant in question.*

The recent British trial is not the only one on record. The American trial of 1899 with S. asperum (then S. asperrimum) was widest in scope. The yields are given in "Forage Crops and Their Culture" Macmillan & Co., New York, 1917), and there is no indication whether the British ton of 2,240 lb. is used or the American short ton of 2,000 lb.

	British Tons?
Ontario	9½
New York State	14 to 16
Vermont	46
North Carolina	6½ to 17½
Wisconsin	32½

The modern Comfrey grower will assume that Wisconsin had a moderately good second-year plot, Vermont was third or fourth year, on poorer soil than Pinner in a season like 1954, that North Carolina gives the yield on poor land with little manure of both a first-year and a second-year field, and in Ontario they grew a third-year plot exactly as the Hannah Dairy Research Institute did in 1945.

There is no published information available to show that this opinion is incorrect, for, though these figures are widely quoted in the U.S.A. and other parts of the world, they neglect age of the plot, method of cultivation, manurial treatment, fertility of soil, and weather. All plots may be of the same variety, grown under the same conditions on identical soils, but even if they are average figures from a three-year trial of established plants to avoid seasonal variation, unless the cultivation methods were those used by experienced farmers, they are completely unreliable as a guide to the possibilities of the crop in the areas concerned.

The same applies to the Continental figures: 36 tons an acre in 1936 in Holland, from plants known to be Symphytum officinale, and 50 tons (S. asperum) an acre in Denmark in the 1940's.[8] As there can be a variation of as much as 400% due to the officially unconsidered factors (perhaps as much as there is between a Highland crofter's potato patch and a fertile field in Lincolnshire), we can conclude that the widely varied opinions of Comfrey are based on differences of skill and experience. Those who in the past and today consider it a high yielding and valuable crop are merely growing it well; those who regard it as a weed have failed through lack of knowledge and unsuitable soil or stock to utilise the yield economically. To a lesser degree this is common to all crops, but in the case of Comfrey, official disfavour and lack of the experimental attention, which all other farm crops have received since 1870, has exaggerated the problem.

8 *"Landbrugets Plantekultur," II, page 377, A. Petersen, Kgl. Vet. og. Landboholakole (Copenhagen, 1950).*

3. YIELD OVERSEAS

The only evidence that any Comfrey has ever been grown in countries outside Europe, apart from the American trial of 1899, is in the Kew Annual Report for 1879. This consists of a list of botanic gardens where it was grown, and some unfavourable opinions from growers in Colombo, Adelaide, Delhi, Singapore and other cities. The opinion of Kew was that the crop was valuable in a temperate climate but of little use in the tropics.

Quotation of this opinion is no longer justified, because of the difference in transport since the 1880's. The Comfrey that went overseas then, before air freight or efficient cool storage at controlled temperatures, mainly travelled as small packets of the very rarely set seed.[9] What finally germinated, and took several years to reach any size, was probably grown no better than the Symphytums in many botanic gardens today, and had little resemblance to the crop grown by Henry Doubleday.

In 1952 I sent the first Symphytum peregrinum to Africa, Webster strain, from my own trial plots, with a warning that it came originally from Russia and that, though I knew what it would do in England, I had no idea whether it would grow well in any tropical or sub-tropical country. The present enthusiasm for the crop among farmers in Africa is based purely on results secured since that date; all I can do is work on the basis of the information supplied by those who grow it successfully. It is, therefore, hoped that still more growers will record their results and pool information. The behaviour of the crop in one country is a very rough guide to its habits in another of nearly similar climate, but altitude and rainfall, especially its spacing through the year and differences, make each new country or district a separate experiment.

It would be desirable for official research to precede the large-scale cultivation of this crop in any country, but until its value has been proved and experience gathered by local farmers, it is impossible for Agricultural Officers and Research Station Directors restricted funds on long chances. Roughly 100,000 offsets were exported in 1954 by Comfrey growers and nurserymen, almost entirely to the Empire and Dominions.

The overseas plots are not described in order of yield, because each must be considered separately owing to the wide difference of conditions, and all are incomplete. This is not only because of the inversion of the seasons in the Southern Hemisphere, but because of the longer cutting periods. No plot overseas is fully established, and

9 *See Thomas Christy, "Forage Crops" (1875), for the difficulties of obtaining this, and Section 6 for the genetical reasons for failure.*

even the oldest is merely recording the second-year yield; that in the first year is too greatly affected by the delays in transit, and the season when it happens to get clear of official restrictions, to be useful.

Offsets can leave England at any time of the year, for choice in the autumn which coincides with the African rainy seasons, generally speaking, and spring in the Southern Hemisphere. Those overseas should endeavour to plant at the season when they can rely on rain to give the plants a start, or can irrigate, whenever this may be. It should be realised that a six weeks' voyage in the ship's vegetable room (cool stowage) does not harm the roots at all, yet a wait in a warehouse in dry heat while officials argue, or a long slow train journey across Africa, will mean losses.

One overseas plot is missing. Mr. Leong Nai Leong of Sarawak, Brilish North Borneo had his Comfrey carried away when the river rose in flood, a further planting on higher ground may be recorded in our next report.

No. 1

Mr. J. M. KING, Waimate, New Zealand

The plants (100), Webster strain, from Mr. Macdonald's stock, were imported late in 1953 after a journey by air that took a month from lifting to planting, owing to restrictions, and they are still under quarantine by the New Zealand Department of Agriculture. Before they went dormant at the end of May 1954, two cuts were taken, the plants grew well and the produce was fed to poultry and goats, who enjoyed it greatly. The land is in good heart but there is only about 10 in. of soil on top of clayey gravel. Mr. King was surprised at the speed with which his rather dried-up plants took root and recovered, despite dry conditions after planting.

This spring (in New Zealand), the first growing points appeared in the middle of September, and though there were several sharp frosts the plants grew on to the first cut with no rain at all.

	Tons	*Cwt.*	*Lb.*
1st cut, October 20th...	7	4	86
2nd cut, December 9th	19	13	6
3rd cut, January 17th...	11	4	81
4th cut, February 13th...	14	19	92
Total for 4 cuts only	52	2	51

The plot had some rain during November but, to quote Mr. King's latest airgraph, "the weather has been very dry for several weeks and the grass paddocks are all drying up very badly, but the Comfrey still grows, but not quite so fast as it would if there was moisture in the ground".

The total yield, with three, March, April and May cuts still to come, is now better than any second-year plot in Britain in 1954, and over four times more than the best yield at Hannah. This is not conclusive evidence that Comfrey grows better in this part of New Zealand than it does in Britain; New Zealand may merely be having the type of summer in which British plots produced the reputed second-year yield of 40-60 tons. Unless, however, the autumn cuts are very small, Mr. King may pass the 1837 record of 87 tons. His third- and fourth-year yields should be of great interest, as the crop has never been grown in New Zealand before, and even its dormant period was completely unknown.

Mr. King provides an example of how best to try Comfrey in a new country. His plot is relatively small, he has risked not more than £7 (including air freight) and his labour, in case it was a complete failure, and he planted on fairly good land, but where he could keep it clean, fed and cut. He has followed British methods until he finds others that suit his conditions better (if any) and, recognising that it is an experimental crop, he is experimenting carefully (his hay sample analysis figures will be included in the next report). By the time he is sure what the crop will do, the plants will be large enough to increase for planting on land that will grow 100 bushels of wheat an acre in a suitable season.

No. 2

Mrs. M. RIDSDALE, Derna Farm, P.O. Box 1702, Salisbury, Southern Rhodesia. Telephone: Salisbury 73757.

The address of this farmer is given in full as her plot is open to inspection by appointment. Visitors should note that a P.O. box number merely means that this is the town from which she collects her mail; both roads and distances are very different to those near Salisbury, Wilts, England.

Her plot in the trial was planted in September 1953. It is Webster strain from my first export of Southery stock, so part of its yield is the equivalent to that of an English one-year-old. Her second cutting season runs from the end of the dormant period; the first cut of it was October 21st, and she will continue until the plants go dormant next dry season, some time in June or July 1955. This will give a complete record of a second-year yield in her area of Southern Rhodesia, but it would be desirable to have others so that an average can level out weather luck and soil, as in Britain.

It is of importance to establish the production in the second and third years (British reputed third-year yield, 60–80 tons an acre), because the common cause of failure in Comfrey trials in all countries is lack of knowledge of the stages of production. A new planted crop is tended carefully but fails to produce 100 tons the first year; it is allowed to become weedy and neglected in the second season. After it fails to grow a heavy yield, with no manure,

it is abandoned and finally ploughed up, to remain as a problem weed, without ever having had a chance to show what it can do when grown well as a crop. The reason is mainly the claims of those who sell it and rarely tell their customers that the first year's yield should be compared with that of first-year lucerne, though, of course, with roughly four times the crude protein to the acre.

	Tons	*Cwt.*	*Lb.*
1st cut, April 22nd ...	13	6	57
2nd cut, May 24th ...	4	11	84
3rd cut, June 13th ...	1	3	39
4th cut, October 21st...	1	5	4
5th cut, November 29th	4	7	98
6th cut, December 19th	4	4	100
7th cut, Jan. 31st, 1955	13	13	74
8th cut, Feb. 28th ...	11	9	77
Total, to date ...	56	2	56

Between early June and November there was no rain at all. As in New Zealand, the crop started without any, but began to move with the rains in early November, and now Mrs. Ridsdale anticipates big cuts and plenty of green food for her poultry grown to British standards (African eggs and table birds are not necessarily the doubtful or skinny native produce known to many travellers).

Before the June cut she wrote: "We have had nearly three weeks of bitter east winds and sharp frosts in the early mornings, which slow things down, but the growth was strong and vigorous and was devoured by my poultry within a few minutes of weighing." At this season at 6 a.m. the ground is white with hoar frost, at 8 a.m. between 50° and 53° F., and by midday 60° to 65°. Sharp night frosts are the rule in many parts of Africa, and it is these that make Comfrey go dormant; the drought can be overcome where it is possible to irrigate, but continued night frosts stop the growth. Mrs. Ridsdale is not using any irrigation, though the plants do get some casual watering, and native gardeners or poultry hands can be very casual indeed.

The dormant period seems about three months—July, August and September—but it looks as though a full season for a second cutting period plot is going to be rather better than any British plot of this age in 1954. It is the consistently high quality of the green food and its long availability without resowing that counts in this climate. One of the problems of the Gambia egg scheme was green-food shortage, and those who feed Comfrey to pigs in Africa consider that it is superior to Edible Canna for palatability. The difficulty is that seeds germinate well in the rains, but only then, and crops run swiftly to fibre, while Comfrey retains its protein.

Mrs. Ridsdale has planted up several larger areas, all on land that has been under poultry and all without irrigation.

No. 3

Mr. H. Dunley-Owen, Salisbury, Southern Rhodesia.

These two farmers are sufficiently near each other for their yields to have the same relationship as those in Britain. The plants here are Webster strain; they arrived very dry by surface mail (not cool store or air freight) on November 23rd, 1953. By November 28th, after a stay in a shallow trench with watering, the roots recovered and began to grow, so all were planted. All plants had leaves flourishing by December 7th. Six plants were kept at Salisbury as a trial and the balance sent to Mr. Dunley-Owen's Inyanga farm, which is 1,000 feet higher than the Salisbury plot.

These few plants have had their yield recorded, the smallest plot in the whole trial, and it should be recognised that calculating an acre from them means a greater chance of error than on the acres and half-acres of England where representative plants can be selected.

	Tons	*Cwt.*	*Lb.*
1st cut, March 13th ...	8	18	30
2nd cut, May 29th ...	9	11	86
3rd cut, end August ...	4	6	48
4th cut, November 26th	8	4	84
5th cut, February 5th ...	17	19	29
Total to date ...	49	0	53

When these plants were first cut they were only 3½ months from planting, but, though Mrs. Ridsdale's are older, they are grown under drier conditions. The small plot was watered frequently to reproduce the effect of irrigation which Mr. Dunley-Owen means to use on his main plantings. It should be recognised that a small plot can be a poor guide other than by a misleadingly high yield, for a field crop with farm dunging and mechanised cultivation by a man who expects a profit from it often puts up a bigger total, while a small patch is a headache on any agricultural enterprise. The yield is sufficiently near to give some collaboration to Mrs. Ridsdale; it is roughly what Comfrey planted after the dry season of 1953 is producing in this part of Southern Rhodesia, with several more rainy season cuts to record.

From the first of June to the end of August, the winter in that area, growth was very slow, but continued, and they started growing again more vigorously from September 1st, but had no dormant period, as in Britain.

The remaining plants, and a further import in August 1954, are in two plots at Inyanga; approximately 30 plants now twelve months old, with no special treatment except a top dressing of manure, and 130 approximately four months old, with manure and lime to start with. If the initial experiment justifies itself, Mr. Dudley-Owen proposes to plant on a field scale from his divided plants. In his view, a 50-ton-an-acre season's yield would justify this, in view of the fodder needs and the production of local crops.

So far the produce has been used for poultry only, but later it will be fed green to cattle or made into silage with a Silorator, perhaps the most suitable bulk harvesting tool for this purpose. We trust that our next report will contain yields from the large plantings at the higher altitude; in Africa not only latitude but height above sea must be considered, and also the mineral demands of the crop. Some areas have trace element deficiencies, and a study of the ash analysis may be valuable in case of failure. Very many European farmers are planting small imports and their experiences would be valuable to others, especially yields after the first dry season when the effect of the voyage or flight has worn off.

No. 4

Mr. A. WALLACE BOSS, Gordon's Bay, Union of South Africa

This plot was planted on January 11th, 1954, with 1,000 plants Webster strain, Macdonald stock. No first-year yields were recorded, but the crop was a vigorous one, and its progress was reported in the "Natal Witness" and other South African periodicals. It gave four cuts, but slowed up in May and June. Normally, Mr. Boss considers that the period out of production is July, August and September; their spring begins about September 15th. The South African winter of 1954 was the coldest on record; it was exactly the same weather as we had in England at the time, with floods, but some severe frosts. By October 22nd the plants were again growing well and the first cut of the second season, to be recorded complete, was taken that month.

	Tons	*Cwt.*	*Lb.*
1st cut, October 30th...	3	15	70
2nd cut, November 23rd	3	12	105
Total, 2 cuts ...	7	8	63

When the cycle is complete, by the end of June, this will be the first yield figure ever recorded in the Union of South Africa, where that of established plants is, of course, as unknown as it is in all the other overseas countries in this trial.

Mr. Boss is a breeder of pedigree Jerseys. He has hitherto used it for calves, but hopes to make hay and silage when he has sufficient knowledge of the possibilities of field scale production. The need in Africa is for a high protein feed; they are many good high starch-equivalent crops, including Napier Fodder, to balance it, or act as silage balancers.

The South African Council for Scientific and Industrial Research (National Nutrition Research Institute) will be carrying out experiments on material supplied from this crop for human food. There is a possibility that the heavy production from a small area may be of value in releasing land for the production of cash crops. It is for this purpose that Messrs. J. E. Lyons have made an experimental planting on their Tanganyika coffee plantations.

No. 5

Lady BETTY MARKHAM, Nairobi, Kenya Colony

This plot is Webster strain, Macdonald stock, and it is growing at 6,700 feet above sea level. The plants (100) were received by air on November 16th, 1953, and planted in an experimental plot, and 2.07 inches of rain fell in the week preceding the arrival of the plants, a further 2.99 inches in the rest of November, and 1.79 inches in December.

All plants got away well, but by the end of December, when the plants were wilting badly in blazing sun, some artificial watering was given. The need in the early stages is to get the leaves up and keep them working to build up the root system; young plants straight from England take some time to grow roots an inch in diameter and up to 12 ft. long to get down to subsoil water. No drought immunity can be expected until the plants are well into the second cutting season. In January 1954 they had 3.92 inches of rain, but all in one great storm, and the sun was very hot both through this month and February, when only 0.74 inches of rain fell.

To quote Lady Markham: "On February 8th, 12 weeks after planting, we cut ten of the biggest plants and secured 15 lb. of leaf, weighed immediately after cutting. To our surprise, the cut plants immediately began to grow again and developed at a much greater rate than the uncut ones." This trial cut was to see what the effect was of cutting in such hot, dry weather, which is, of course, when stock feed is wanted in Africa. March had only 0.08 inches of rain, but they cut again and got 32 lb. of leaves off 91 plants. On April 1st the long rains started, 19.34 inches in April and 5.86 up to May 14th, and "the Comfrey simply romped away". Two plants cut then yielded 149 leaves weighing 6½ lb. and one of 101 leaves, 5½ lb.

The plot came into the trial with the cut of June 5th, 1954, with an average of 4 lb. 11.2 oz. a plant from 83; the best weighed 10 lb. each.

	Tons	*Cwt.*	*Lb.*
1st cut, June 5th ...	10	3	12
2nd cut, July 16th ...	5	5	67
Total, 2 cuts ...	15	8	79

After this fine beginning for a first-year plot there was a long silence, but some yield figures have been recorded, though

they have not yet arrived. The farm had a bad attack of foot-and-mouth disease, which does not mean the sudden loss by slaughtering in Kenya, but time-consuming dressings that go on for a long period. Then a gang of 30 Mau Mau raided the native labour lines, and ever since then Lady Markham has had to endure problems worse than those of any other farm in the trial. It makes no difference whether one's labour is jailed as suspected Mau Mau, beaten up by the police by mistake or away giving evidence, whatever happens the work gets behind. One of the Mau Mau "Generals" was arrested when asleep under a pile of leaves in her coffee plantation, a gang of six Mau Mau were shot in a fight just opposite her farm, and at one time she was left with only two garden boys unarrested. Guilty or innocent, this makes for difficult farming. Among the many first in history records set up by plots in this trial, Lady Markham and her manager are the first people ever to cut and weigh Comfrey with automatic pistols in their belts.

She is feeding her Comfrey chaffed and mixed with the normal fodder to her pedigree Jerseys (two firsts and two seconds in this year's Royal Agricultural Society of Kenya Show) as part of the production ration. In her climate the crop seems to spread outwards rather than up, plants 2 ft. high and 4 to 5 ft. across, and even 5 ft. between each (instead of three as in England) might well pay. It is hoped that when peace returns to Kenya she will have a better opportunity to check the view that the crop grows all the year round in the absence of frosts. It does, it seems, but the many Kenya plantings are rather badly placed for agricultural research at present; the weather in Britain is very much easier to overcome than the Mau Mau as a hazard of farming.

CONCLUSIONS ON THE OVERSEAS PLOTS

The sustained production in countries of erratic rainfall makes this crop merit the serious attention of those officially concerned with agriculture in the areas where the plots in the trial are growing and others where the conditions are roughly the same. The need is to work by the methods used on successful farms; these are exactly the same as in England at present. There has been no time for long-term trials to discover new methods to suit different conditions but, in every case, standard British cultivations should be the "Control". "Keep it Clean, Keep it Fed, Keep it Cut" are still the ruling principles in every part of the world.

The crop must be regarded as experimental, but it is essential that experiments should be carried out, not only for yield, but the season over which it is fed and the stock-feeding that pays. A small plot in a garden should be cultivated always with an eye to how much work the same operation would be on five acres, how could it be mechanised and what difference it would make to stocking. In Africa root growth is more rapid; Mrs. Greer's system of propagation could be applied repeatedly in the rainy season to increase the stock, when the yield and value has been proved on a farm. More information on cattle feeding in Africa is required. We know that it is very good for poultry and pigs, but as yet there has been no large-scale hay- or meal-making.

The crop has not yet been grown on the West Coast in high humidity and heat, what most untravelled people think of as the tropics. New plantings in Nigeria and the Gold Coast may give us news by our next Report, and the replanting of the Sarawak plot adds a further variation. In every case, the comparison is with the existing crops; where land is cheap and labour scarce, it may pay to take a large weight of feed off a small area, or it may not. The need is for trial by those who can afford to take a long-term view and risk failure, because there is no sure knowledge of what this plant will do anywhere in the world until it has been tried. The evidence is that it is worth trying, and worth perseverance to find the eventual yield, which may well be enough to make a very real economic difference in many lands. New plantings on St. Helena, Cyprus, Ceylon, Trinidad, Jamaica and other islands with population problems may supply more information in our next Report.

4. CONSERVATION AS HAY AND MEAL

The main reason for the decline in popularity of Comfrey after the heavy yields of the 1890's was lack of knowledge on conservation. The bulk of green fodder comes at a time when many farms have ample grass. Orthodox hay cannot be made from it as the heavy foliage heats before it can dry in Britain, and the silage methods of the 1890's (notably George Fry's Sweet Ensilage process which employed no molasses) were entirely unsuitable. Most references to the difficulties of conservation in agricultural works of even recent date come from the failures of this period.

The work in the trial was restricted to those methods which did not involve capital expenditure by using existing materials and appliances on the farms concerned. Though the lack of finance which imposed this condition was a disadvantage, this is outweighed by the advantage that any farmer can repeat our experiments and test the product on his own stock, any Research Station can check our results (provided all factors are constant) at low cost, and smallholders or peasants in any country can try

Fig. 2

The wide ratio of protein to fibre fits this crop to the pigs digestion, and they not only eat every bit of the foliage they can get, they will destroy the crop utterly by rooting if they are folded on it. It is both a meal saver and a scour preventer, and pigs are the most profitable stock to use it.

Fig. 3

The Holbrook Junior Young Farmers Club beside their trial plots soon after a cut. They tested four different strains and made hay with about the same protein and fibre as feeding beans. By the time these keen 14-year-olds have farms of their own, we shall know a great deal more about this crop.

Fig. 4

Across the Atlantic "Russian" becomes "Quaker" Comfrey. Here is Messrs. Bodie Seeds Ltd., Winnipeg trial ground, the first acre ever planted in the American continent, the 1899 trial was ofsmaller plots with Symphytum asperrimum, this S. peregrinum and it is growing well.

Fig. 5

Mr. E. V. Stephenson the Yorkshire stud farmer in the 2-year-old plot that yield best in all Britain on poor wold land. He grumbled at his yield, after 16 years Comfrey growing he considers 1954 the worst season yet, it saves him 17/6 a week on hay in summer for every beast, and in 1955 hay good enough for race horses will be scarce and dear.

Fig. 6

Mrs. (and Master) Paul Weir in the plot that pulled up from bottom to eights best, 4th highest second year plot on marginal cleared woodland in Hampshire, poultry manure in June pulled it ahead after a slow start. This plot is one of several sited for easy cutting and tossing into the pig paddocks.

Fig. 7

A 10-lb. Russian Comfrey plant ready to cut, with a 3-gallon watering can to show the size. This was photographed at Southery Norfolk in 1950, on a plot that gave 36 tons an acre as a first year yield, land that has since given 2½ tons of wheat an acre. It is the first photograph ever taken of Henry Doubleday's plant grown by his methods.

Fig. 8

Half an acre of Webster Strain from the original Southery Trial Plots, on Mrs. Greer's farm near Colchester. These plants were propagated by her method, photographed in July, and in April they had produced the 5,000 offsets that went to Messrs. Bodie Seeds, the Quaker Comfrey of Canada and the U.S.A.

how the methods suit their conditions without risking more than they can afford.

Methods Used

It is perhaps best to begin with one that proved a complete failure. Tripod hay was made for the first time in history by Mr. J. C. Quicke with about half an acre of his May cut, using standard Proctor tripods, but apart from the weather, to get cut Comfrey foliage to cling on a tripod, it must be piled too thick for air circulation. Grass holds together, leaving air spaces when piled loosely; Comfrey foliage does not. The crop simply blackened and rotted on the tripods. Mr. Newman Turner repeated the experiment in June, with the same result. Both farmers have long experience in making tripod hay. They made a quantity of the normal product with grass at the same time with complete success, and though it is possible that a very hot, dry summer would give better results, it is unlikely.

The most popular method, used by five of the plots, was the Roof Top or Shed Roof System. This was discovered in the summer of 1953 on Mr. E. V. Stephenson's farm by this pioneer Comfrey grower and myself. Green Comfrey is forked on to a corrugated iron roof in a thin layer, roughly two inches thick, and left in the rain and sun until the midribs and stems are dry enough to snap like sticks. From the evidence of the samples in the tables this indicated between 10% and 15% moisture. It is then raked down and either stacked in a dutch barn or, because the leaves are inclined to shatter, put through a hammer-mill and used as a pig or poultry meal.

The first analysis, from June-cut Stephenson strain Comfrey, was made by Mr. S. M. Boden of Leeds for Mr. J. W. Hancock, Horticultural Advisory Officer for the East Riding of Yorkshire (Beverley Headquarters). It was 25.2% crude protein to 14.4% fibre, and it was the prospect of securing something like a very high-grade grass meal, but with half as much fibre, by such a cheap and simple method, that led to its adoption in the trial.

The principle is that the ridges of the corrugated iron let the air under the foliage, the roof slope and the hollows run the rain away to give quicker drying, and, as the crop wilts to smaller bulk, the exposed bitumen-painted (no roof was bright galvanised) surfaces warm up by the greater absorption of sun heat. If the roof is that of a pigsty or the building is unlined, the by-product effect of cooler conditions inside is secured.

The method is unlikely to be of value for any other crop, it owes its success to the peculiar qualities of Comfrey, and is, like all outdoor haymaking methods, dependent on weather. In 1954 it was tried under the very worst conditions and very rarely fell below the protein standards of the best lucerne hay; the few samples in the tables which had good weather show its possibilities in a season with more sun.

The procedure is to cut, load on to a tractor trailer, drive beside the eaves and pitch it up with hay-forks; when a test of the dryness by stem-snapping shows it is ready, it is merely raked down in the same way. As long as it dries within three weeks the quality will be up to standard, and this releases the roof for the next cut. It has the disadvantage that a considerable area of roof is required (quicker drying in a week or five days produces more hay per roof), and the wind risk. The shed should be sheltered from the prevailing winds but in full sun if possible. The invention of the Holbrook Y.F.C., a net to keep it on, is useful in some circumstances; something like a tennis court surround net or a pig net could be used, but it presents difficulties on a larger scale.

The immediate advantages were that every farmer in the trial had a suitable shed and could carry out the procedure at small labour cost. The labour involved is rather more than pitching grass into a drier, the foliage had to be thrown from the trailer level up to the roof, for no mechanised method was worth devising until the results had been tested. On the other hand, the removal of the fuel cost of approximately £5 per ton dried, plus interest on capital and depreciation on an orthodox grass drier, for a product of often higher protein content, gives some margin for the extra labour. In the opinion of the growers, this was the easiest hay they made in 1954, though in a better year the contrast might not be so striking.

The second method was the rack. These varied according to the material available. Mrs. P. B. Greer used worn-out gravel screens, flattened by running a tractor over them, and old Army bedsteads; Mr. P. Weir, expanded metal of the grade used by plasterers; and Miss Arundel, the wire netting doors of poultry runs. The Guide Post School made a frame with expanded metal which was hung in a pillared corridor, roofed, but with open sides. Mrs. Greer stood her racks in a dry shed with corrugated iron roof and sides; Mr. Weir protected his in the same way; but, for the one sample Miss Arundel was able to do, the doors were propped flat on posts in the open, exposed to weather.

The idea was to try whether free circulation of air from both sides on racks singly or in tiers under cover would produce a better hay, dried more quickly and without weather risk. It was found very important not to spread the foliage too thickly on the racks, or heating occurred, and the main need was a free circulation of air. The high humidity of 1954 in Britain, plus the small scale of the trials, make further research desirable and justified by the fact

that the highest protein samples came from the rack driers.

A likely development is the Kenya Lucerne Hay Barn, which is used in parts of Africa where the conservation surplus of the crop is produced in the rainy season. This is a straight-roofed dutch barn-like structure containing bamboo racks, which follow the roof slope, one above the other. The bamboos are about 10 ft. long, lashed about 2 in. apart to cross-pieces running the length of the barn, so that the hay can be slid up in layers one above the other on both sides. The roof gives protection from the rain; temporary sides can be put in place if driving rain defeats the careful siting of the barn.

In Africa and other tropical countries the dry season production is of such value for direct feeding to stock that hay to store for the dormant period (if any), which is of shorter duration than in Britain, must be made in the rains; therefore this method has wide application and further reports should yield useful results. In England it may solve the problem of the roof area, with six or seven times the area occupied for a shorter period, without weather risk. It is hoped to test prototypes at Bocking of this device which uses the principle employed by the inhabitants of St. Kilda before the 1931 evacuation to make their hay in "clents", stone buildings sited so that the strong prevailing winds gave them the first successful application of "cold blowing" to crop conservation in the world.

The two African samples in the table were made by hanging up bunches of foliage in sheds. With native labour experienced in tying up tobacco leaves in the same way, even this has possibilities, when the cost and haulage charges of concentrates are considered under local conditions. The object was to make sure of getting the first dried Comfrey samples ever made in that continent; both farmers feared that the hay at that time would be injured by the direct sun. Further samples will be made, for even African temperatures are not as high as those in a Templewood drier. It will be a matter of learning the best season for conservation, in view of the stock needs at each period.

Apart from the boiler-room sample made in this way, used by goatkeepers on a small scale, one other method was tried. Mr. Newman Turner put part of his October cut on a fence to reproduce the Norwegian haymaking method that employs long, low "tripods" across the fields. The result was not promising, but in view of the weather at the time and the lateness of the season, further trials would be desirable. With all attempts to apply grass or other forage crop conservation methods to Comfrey, the bulk and weight must be considered. A cut of Comfrey worth conserving is going to weigh approximately 10 tons an acre, roughly four times as much as a grass yield to give a ton of hay. Experience with other crops is not a guide to the behaviour of Comfrey, and the recognition of this fact is a most desirable innovation.

The first two methods and variations on them, developed by further research, appear to offer the best dry conservation system yet invented for the crop. They are, however, more suited for the production of relatively low tonnages of concentrates on the farm or smallholding than for use by the commercial crop drier supplying compounders.

No experiments with barn hay driers, cold or warm air or orthodox high-temperature grass driers were carried out, because none of the growers use these appliances and no funds were available to build prototypes to suit the needs of the crop. We know that it can be dried in a normal drier, using a "Robust" or other shredder, as with kale or sugar-beet tops, to overcome the difficulty of leaf drying more quickly than stem that these crops share with Comfrey. We do not know how far wilting in the field to reduce the moisture content before harvesting by buck-rake and shredding will reduce drying costs. The consistently higher protein and lower fibre makes the crop more attractive to the drier who uses as much fuel to evaporate the moisture from "maintenance quality" in the 14% protein class as the higher-priced 20–25% grades. It is also more attractive to the compounder because it appears highly suitable for pigs and poultry, if it is available in quantity. We should be very glad to co-operate with any commercial crop drier who is prepared to experiment. In this connection it should be realised that the R.A.S.E. Grass Drying Competition in 1953 was won with 5 tons of dried meal per acre; even a 50-ton Comfrey yield produces 8 tons on a 10% moisture basis.

ANALYSIS OF DRIED COMFREY IN THE 1954 TRIAL

The species or strain is given in every case. For discussion of each method see text. Analysis by Messrs. Horace Ward, except where stated.

	Protein	*Fibre*	*Carbo-hydrate*	*Oil*	*Ash*	*Moisture*	*Beta Carotene mg. per kg.*
	%	%	%	%	%	%	%
Mrs. P. B. Greer.							
Webster Strain.							
Rack Dried.							
May 22nd	33.68	9.36	32.23	2.17	14.89	7.73	194
June 22nd	26.59	10.59	32.21	1.57	17.60	11.44	176
July 26th	23.03	12.07	31.41	1.23	15.56	16.70	173
September 28th	23.58	12.00	35.64	1.34	16.55	10.89	121
October 22nd (B.O. & C.M.)	18.80	10.64	38.06	1.33	18.40	12.77	
Mr. P. Weir.							
Webster Strain.							
Rack Dried. Under Cover.							
May 13th	28.86	9.75	26.45	1.63	10.11	17.20	144
June 11th	25.43	10.30	31.99	1.02	19.89	19.54	
August 11th	23.38	13.00	29.63	0.99	16.17	16.83	
Mr. I. G. Macdonald.							
Webster Strain.							
Shed Roof.							
May 10th	24.17	9.35	35.85	1.41	16.13	13.09	97
June 12th	31.15	10.15	31.99	0.77	11.11	15.00	
July 11th	24.41	15.59	33.38	0.36	10.63	16.03	
Oast House Dried.							
July 28th	20.73	13.83	33.38	1.00	10.18	16.50	175
August 1st	20.57	11.55	34.73	1.32	17.76	14.91	207
November 3rd	16.60	8.52	37.40	1.59	24.74	11.15	
Boiler Room (Hung).							
October 28th	22.30	9.29	36.81	1.36	16.57	13.67	
Mr. J. C. Wylie.							
Webster Strain.							
Shed Roof.							
May 22nd	28.77	12.77	28.00	0.97	9.90	14.09	
Mrs. Furness.							
Stephenson Strain.							
Shed Roof.							
May 22nd	19.50	19.20	36.81	0.84	9.90	13.75	
August 1st	22.25	11.07	34.73	1.21	15.14	15.60	
Mr. J. Lackenby.							
Webster Strain.							
Shed Roof.							
May 15th	29.14	16.18	31.33	0.91	11.65	10.79	
Mrs. M. Ridsdale, Southern Rhodesia.							
Webster Strain.							
May 24th	20.44	9.69	36.70	1.77	18.75	12.66	277
Mr. H. Dunley-Owen, Southern Rhodesia.							
Webster Strain.							
August 30th (S.R.G.C.) ...	21.40	10.90	35.20	3.40	21.40	10.40	
Miss Arundel.							
Stephenson Strain.							
Rack in Open.							
May 24th (B.O. & C.M.) ...	24.50	10.76	35.44	1.16	10.46	17.68	
Mr. F. Newman Turner.							
Old Strain.							
Norwegian Hay.							
October 19th	17.32	13.62	34.72	0.79	17.74	15.81	

	Protein	Fibre	Carbo-hydrate	Oil	Ash	Moisture	Beta Carotene mg. per kg.
	%	%	%	%	%	%	%
GUIDE POST SCHOOL.							
Webster Strain.							
Rack Indoors.							
August 21st	18.80	11.36	37.97	1.15	17.30	13.42	
September 23rd	18.71	11.26	41.06	1.34	17.87	9.76	179
COL. P. BENCE-JONES.							
Rack Under Cover.							
June 4th, *Doubleday* ...	25.04	10.82	32.61	1.10	15.96	15.32	
June 4th, ,, *Flowering*	18.44	14.37	42.02	0.80	12.32	15.05	
June 19th, *Stephenson* ...	22.84	12.17	32.61	1.10	15.96	15.32	
HOLBROOK Y.F.C.							
All Shed Roof.							
Webster Strain.							
May 5th	26.37	7.15	36.72	1.69	14.95	13.12	157
June 2nd	23.19	11.40	23.72	0.64	24.68	16.58	
July 2nd	21.61	10.89	34.45	0.84	19.27	12.94	89
August 10th	17.87	10.24	32.46	0.67	27.79	10.97	14
October 13th	14.00	9.40	33.14	0.82	29.45	13.19	33
Stephenson Broad Strain.							
May 5th	24.43	6.90	36.72	1.69	20.86	12.12	150
June 2nd	22.65	10.30	29.41	0.47	24.83	12.34	
July 2nd	18.87	12.56	35.38	0.42	19.76	13.01	
August 10th (B.O. & C.M.)	18.60	8.06		0.66		11.52	
October 13th	13.05	8.59	27.44	0.49	38.09	12.34	30
Stephenson Narrow Strain.							
May 5th	24.00	9.00	38.10	1.95	14.17	12.78	130
June 2nd	17.11	18.50	35.43	0.75	15.81	12.40	
July 2nd	18.11	14.33	37.09	0.62	14.66	15.21	
August 10th	17.15	10.44	31.90	0.63	29.56	10.32	31
October 13th	15.40	10.57	34.48	1.02	25.38	13.15	36
Holmes Strain.							
May 5th	22.17	7.60	37.21	1.37	10.60	12.25	156
June 2nd	24.51	13.70	28.39	0.64	20.04	12.96	
July 2nd	17.98	12.40	32.25	0.63	24.50	12.24	
August 10th (B.O. & C.M.)	19.00	7.36		0.63		11.52	
October 13th	15.64	9.96	30.45	0.97	29.24	13.74	55
MESSRS. HEATH & HEATHER.							
Symphytum Officinale.							
Herbalists' Dried Comfrey ...	17.48	12.38	40.05	1.38	16.26	12.45	
I.C.I. TRAY GRASS DRIER.							
August 1951.							
Webster Strain (Southery) ..	21.80	14.00	37.40	2.10	13.60	8.10	
TEMPLEWOOD GRASS DRIER.							
1945 (Hannah).							
Holmes Strain	22.70	10.90	38.20	2.70	14.50	11.00	400

Notes on Analysis: "B.O. & C.M." figures are from Messrs. Unilever's laboratories, and not all are as full as those by Horace Ward. "S.R.G.C." is the Southern Rhodesian Government Chemist. In the case of Messrs. Heath & Heather's herbalists' Comfrey, like that of the sample of Holmes strain dried at the Hannah Dairy Research Institute, the analysis is valuable as an indication only; the cutting stage and date are unknown.

CONCLUSIONS FROM THE ANALYSIS FIGURES OF DRIED COMFREY

Weather, soil and cutting stage all influenced the composition of these samples, so any factors which appear constant in all cases (that apply irrespective of the drying method employed) can be regarded as objective facts. The evidence is from sufficient samples to rule out freak results from single tests; it represents the greatest number of analysis figures relating to this crop ever made in any country. Each sample was sent to the analyst in bulk in a small sack, to avoid the risk of error from unskilled sampling on the farm. In some cases the material was reduced to powder by the hammer-mill, but tests of the same material unmilled showed that there was no important difference in the composition.

The first factor common to all samples is that they begin in May with the highest protein, and that this falls in the autumn: in some cases the peak is delayed until June, and in others it is masked by differences in weather luck. The picture is clearest with the rack-dried material, as here the conditions are almost the same at each cut, only the plant has altered. The fresh weight analysis figures confirm this discovery, which is merely that Comfrey is like grass in the protein balance through the year. The opinions expressed in the past that it is "a watery feed" are probably due to the time of year at which the sample was taken: late aftermath samples of a good pasture grass would be just as misleading as a guide to the value of grazing in spring and early summer.

Another important point established by Col. P. Bence-Jones's deliberate cutting of his Doubleday strain at both stages, and Mrs. Furness's trial of late May in flower, and August in leaf, is that, just like grass and lucerne, the cutting stage makes a difference to the analysis. As the crop runs to stem and flower, up goes the fibre and down goes the protein. Analysis figures of hay, lucerne hay or kale are always given in relation to the stage of growth at the time of cutting. We now know definitely in terms of analysis what has been common knowledge among Comfrey growers for 80 years.

The other characteristic of all samples is the remarkably high protein. The very worst sample with the worst drying weather is higher in protein than the very best meadow hay, and with the October 13th cut of the Holbrook Y.F.C. left out, the other October cuts dried by other methods come in the class of 16% to 18% protein Lucerne Hay, cut in half-flower or before flowering in the height of summer. Linked with this very high protein is low fibre. Unless the crop is deliberately allowed to flower, there appears to be between half as much again more protein than fibre to over three times as much. This very wide ratio explains many of the characteristics of the fodder—the great appetite pigs have for it, the need to balance the protein with carbohydrate, the greater liveweight gain in the early stages and the need to increase the barley meal or other starchy ration as they come on to bacon weight, and the failure of an all-Comfrey diet for cattle or goats.

From these figures it appears that even the most unsuccessful farmers in the trial have been making a concentrate, and before we discuss the details of their success or its reverse, it is relevant to compare the product with other feedingstuffs.

The following table of the concentrates nearest in analysis to the dried Comfrey from the 1954 trial is quoted from the Ministry of Agriculture Bulletin 48. Prices vary, but the grades of the materials quoted can be compared with prices in the farming press, so a theoretical valuation can be applied to Comfrey hay, bearing in mind that the analysis comparison is not exact and that the well-known feedingstuff may have qualities that the untested product does not. It is quite as possible that further research will reveal new advantages as well as drawbacks, but it should be clearly understood that no Research Station concerned with animal nutrition has ever carried out serious work on dried Comfrey, in any country in the world.

	Protein	Fibre	Carbo-hydrate	Oil	Ash	Total dry matter
	%	%	%	%	%	%
Soya Beans (Whole)	33.20	4.10	30.50	17.50	3.40	90.00
Super Quality Grass Meal (Southery Farms Ltd., April 1954)	30.90	12.10				92.45
Groundnut Meal (Undecorated and Extracted)	31.80	25.30	29.10	1.90	4.30	92.40
Cotton Cake (Egyptian)	23.20	21.30	32.60	5.00	5.80	87.90
Cotton Cake (Bombay)	20.20	21.70	35.20	4.80	5.80	87.70
Good Dried Grass Meal	20.30	14.00	41.90	5.80	8.00	90.00
Dried Sugar Beet Tops	16.23	11.18	48.92	2.10	13.60	86.70
Feed Beans	25.40	7.10	48.50	1.50	3.20	85.70
Lentils	25.50	3.40	52.20	1.90	3.00	86.00
Lucerne Hay (Before Flowering) ...	16.20	27.00	29.20	2.40	7.30	84.00

	Protein	Fibre	Carbo-hydrate	Oil	Ash	Total dry matter
	%	%	%	%	%	%
Lucerne Hay (Half-flower)	18.90	25.40	30.60	1.10	8.00	84.00
Lucerne Leaf Meal (American) ...	21.40	24.50	40.60	1.90	10.20	91.00
Very Good Red Clover Hay	15.30	22.20	35.80	3.20	7.00	83.50
Worst Russian Comfrey (October Cut, Heavy Rain, on Shed Roof) ...	13.05	8.59	27.44	0.49	38.09	87.66
Average, August 1954 (Shed Roof) ...	22.25	11.07	34.73	0.97	15.14	84.40
Average, May 1954 (Shed Roof) ...	26.37	7.15	36.72	1.69	13.12	84.88
Best Sample of 48 (Rack Dried) ...	33.68	9.36	32.23	2.12	14.89	92.27

These comparative figures show that dried Comfrey is relatively high in ash. The analysis of a good sample can be compared with a legume seed, an average one with cottonseed cake but lower fibre, and the very worst with good meadow or clover hay. It is the prospect of producing vegetable protein in conjunction with fibre low enough for pigs and poultry, or human food, in quantities of between 8 and 16 tons an acre instead of the vastly lower yields of legumes of comparable analysis that justifies our research and the voluntary work of our helpers in all countries. It should be understood that this is a prospect only, and our evidence justifies only further research to confirm our results and develop those prospects that do not prove to be false when experimental work of wider scope can be undertaken.

THE DISCOVERIES OF THE COMFREY DRIERS

The most important principle established during the season was that on which the roof-drying system rests. It appears that the protein in Comfrey is far more weather-resistant than that of grass, and as long as the crop dries in the end a high protein product results. The oil goes first, then the carbohydrates break down, and this damage to the starches and sugars produces a blackening of the hay which does not appear to effect its palatability. Two samples which illustrate this were those of Mr. J. Lackenby and Mr. J. C. Wylie, both with the same strain at approximately the same stage and cutting date. The Yorkshire plot stayed on the piggery roof about a month, the Scottish one for six weeks, and as soon as it became nearly dry it was again rained on. Both are lower in oil than rack-dried or weather-fortunate samples cut near the same date.

On the other hand, good weather produces the best results. The series of remarkable samples from the Holbrook Y.F.C. cut on May 5th dried in four days, in hot sun, and not one of their other batches were made under these conditions. The oil column reflects this, but their high ash for a more slowly growing crop without manure indicates another factor. It appears that manurial treatment has an influence on the amount of the ash; the low figure for Mr. Lackenby may be an illustration.

It seems that somewhere between a fortnight and three weeks, in all weathers on the roof, is about the limit for a high-quality Comfrey hay. None of the samples were turned, no more work was put in than in throwing up and raking down, and this rain tolerance may balance some of the obvious disadvantages of the system.

The problem with rack drying is humidity, and the difficulty of securing sufficient air changes to take away the moisture, after wilting is over—and a surprising quantity of water comes off in this way—meant drying was protracted, and it was possible for carbohydrate and oil loss to take place. Compare Mrs. Greer and Mr. P. Weir, the difference was one of extra draught, and the Guide Post School, though with low, late season protein, hold the risen carbohydrate because of the draughtiness of their corridor. Some form of fan may be the answer, and further research is advisable.

This slow drying, as can be expected, results in a produce low in Beta Carotene (Vitamin A), compared with dried grass. The only fresh weight determination of this substance was made by Dr. Vernon Booth of the Dunn Nutritional Laboratory, Cambridge, in August, at Southery, where I began my work on this crop with Messrs. Wissington Estates. It was 77 mg. per kg., but to obtain a complete picture of this substance in Comfrey a series of samples would have to be tested through a complete season at the same growth stage. This quantity is adequate for stock where it is fed fresh.

The highest carotene in dried Comfrey was 400 mg. per kg. in the sample dried at Hannah Dairy Research Institute, in a Templewood drier, in 1945. Second with 277 mg. per kg. comes Mrs. Ridsdale with swift drying from African sun beating on her shed; next Mr. Macdonald's August batch in his oast house; then the draughty school corridor; and then the better rack samples with the quick-dried May 5th cut of Webster strain at Holbrook leading the shed roof driers. In fact, the result is what

anyone experienced in the analysis of artificially dried crops would expect. The amount in the better samples compares with 25% of the dried grass made in Britain in 1953; 53.9%, however, was between 200 and 299 mg. per kg. It should be realised that no form of orthodox hay would have retained so much carotene even under the best conditions.

Compounders today are rarely interested in buying dried grass on a basis of carotene, because this substance is affected by light, oxidises and rises and falls erratically in store, so that material bought expensively on a high analysis may fall and vice versa. In order to test this, a series of trials were made with Mrs. Ridsdale's sample by Messrs. Horace Ward, to discover if the carotene of Comfrey behaved in the same way as that of grass or lucerne.

	mg. per kg.
July 14th, 1954	277
September 24th	305
October 21st	227
November 19th	222

Though it is unlikely that this variation was peculiar to African-grown Comfrey, two British tests were made.

MRS. P. GREER—WEBSTER STRAIN

Cut June 22nd	mg. per kg.
Tested July 14th	176
Tested October 21st ...	123

HOLBROOK Y.F.C.—WEBSTER STRAIN

Cut July 2nd	mg. per kg.
Tested July 22nd	89
Tested October 21st ...	62

Had the results proved markedly different, the series would have been continued, but it appears to be reasonably certain that the carotene of Comfrey is no different to that of any other plant. The seasonal pattern of Mrs. Greer's rack-dried samples makes it probable that the carotene peak is in the spring; freshweight tests may well confirm this.

FRESHWEIGHT ANALYSIS

These freshweight samples are unfortunately an incomplete series and it is hoped that a complete set can be made at Bocking. They were taken with great care to preserve the moisture and to give a test of the crop as grazed. As fed wilted, the moisture is less and the balance more concentrated. It should be noted that no samples in this Report are on a "dry matter basis"; all include moisture. This is mentioned because since Dr. Auguste Voelcker's first analysis of Symphytum asperum in 1879,[10] there have been many cases of nurserymen who sell any variety of Comfrey quoting a dry matter based analysis showing 25% to 30% protein, compared with other fodder crops including the moisture, giving a totally misleading impression both to buyers and to research workers, who mistake ignorance for fraud.

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COMPARATIVE ANALYSIS OF COMFREY AND OTHER CROPS

Unless otherwise stated, from Ministry of Agriculture Bulletin 48

	Moisture	Protein	Fibre	Carbo-hydrate	Oil	Ash
	%	%	%	%	%	%
J. C. Wylie, June 11th (Dumfries County Laboratory)	84.90	5.15	1.26			2.37
J. C. Wylie, August 20th (Dumfries County Laboratory)	89.42	3.10	1.16			1.76
The above cut on Dry Matter Basis ...		29.30	11.00			
Comfrey (Russian)	87.60	3.40	1.50	4.90	0.30	2.30
Comfrey	88.50	2.50	1.70	5.00	0.30	1.50
Cabbage (Drumhead)	89.00	1.50	2.00	5.90	0.40	1.20
Marrowstem Kale (Unthinned)	86.00	2.10	2.00	6.90	0.50	1.90
Pasture Grass (Rotational)	80.00	3.50	3.10	8.90	1.10	2.10
Ryegrass (Perennial)	75.40	2.90	7.10	11.50	0.60	2.60
Sorghum (Foliage)	80.10	2.10	6.20	9.60	0.60	1.40
Lucerne (Before Bud)	85.00	3.80	3.30	5.70	0.40	2.40
Lucerne (Early Flower)	76.00	4.10	7.20	9.90	0.40	2.40
Red Clover (Beginning to Flower) ...	81.00	3.40	4.50	8.10	0.70	1.60

It will be seen that the crude protein in fresh Comfrey is higher than that in anything other than a legume, the carbohydrate lower and the fibre very much lower than all other crops, and that the mineral content (ash) is about the same as that of lucerne. Any comparative table is misleading to some degree because it neglects both the special advantages of each crop (as the nitrogen-fixing power of the legumes and the ability of lucerne, as an example, to thrive on thin chalk where

Comfrey never does well), and also the yield. An illustration is marrowstem kale. A 50-ton crop could be grown, but the fibre would be far higher and palatability much lower than about 15 tons, sown late to dodge the fly, unthinned, like the one in the table. A late cut of Comfrey, average 7-8 lb. per plant, would give the same weight and in the autumn would be very roughly the same protein, though lower in starch equivalent, but the five or six previous cuts would have been taken with very much less labour and other costs than the same number of moderate-sized kale crops off the same land in one season, even if this were possible.

The factor of digestibility of the crude nutriments revealed by analysis arises. These are established by nutritional tests, and there have been none on Symphytum peregrinum. There have been small-scale trials, and widely quoted opinions have been formed from them, but these, however eminent the authority, neglect so many factors (cutting stage, variety, cultivations and manurial treatment) that the poorly recorded and haphazard experiences of working farmers, recorded in the next section, are of equal value.

The analysis of "Comfrey" under "Miscellaneous" on page 116 of Bulletin 48 is from a German source.[11] It is, therefore, probably Symphytum asperum, the Prickly Comfrey, but it could be a late cut of S. peregrinum. An early cut would have been much higher in protein; the June 11th fresh analysis is the best ever recorded, because it is probably the earliest in the year that one has ever been made. It is perfectly credible, in view of the roof-top hay made by Mr. Macdonald a day later with the same strain, at the same stage (though in Kent, not Scotland), with 31.15% protein to 10.15% fibre.

11 *Confirmed by Professor W. E. Woodhead, M.A., Ph.D., D.Sc.*

	Digestible Crude Protein	*Digestible True Protein*	*Digestible Fibre*	*Digestible Carbo-hydrate*	*Digestible Oil*	*Starch Equivalent per 100 lb.*
	%	%	%	%	%	
Comfrey (?) ...	1.50	0.90	0.80	3.70	0.20	5.20
Cabbage	1.10	0.70	1.40	4.60	0.20	6.60
Marrowstem Kale	1.70	1.20	1.60	7.20	0.30	9.10
Pasture Grass ...	2.60	2.30	3.70	7.60	0.50	13.40
Ryegrass	1.80	1.30	4.00	7.40	0.30	10.60
Sorghum	1.20	0.70	3.30	5.80	0.20	8.00
Lucerne (B.B.) ...	3.20	2.10	2.10	4.60	0.13	9.00
Lucerne (E.F.) ...	3.10	2.40	3.20	6.60	0.10	10.30
Red Clover ...	2.50	1.70	3.00	5.20	0.50	8.90

This comparison of an unknown but low-grade Comfrey, with the examples of higher grade and recorded cutting stage from the previous table, should be treated with reserve as nothing is known of the early trials which are the sole evidence on the digestibility of Comfrey. They show that the proportion of the protein which is digestible as about the same as that of perennial ryegrass, and slightly better than that of lucerne cut at the early flowering stage; that is to say, that though the crude protein is higher in quantity in lucerne, a lesser proportion of the greater amount is digestible. The differences from working with known strains grown well on a modern farm could be calculated, but there is sufficient evidence to justify further experimental work, rather than to work mathematically from figures out of the past that may be inaccurate.

To the farmer these figures are mainly of value in confirming what has been already discovered by other farmers. Comfrey is high protein, low starch equivalent and very low fibre. A straight Comfrey diet means trouble, but as it is a cheap bulk feed he can "level out the decimals with a few extra forkfuls", and balance on carbohydrates, which are almost always far cheaper than proteins. The greatest economic gain is where low fibre is a real advantage, as with pigs and poultry, or where starch equivalent can be supplied as roughage.

Ash Analysis

As Comfrey is high in minerals and the proportion is increased in late season and where drying methods have lowered the quantity of other constituents, a series of full tests were taken by Messrs. Horace Ward. As these included trace elements, their cost was so high that it was not possible to carry out one at each cut on each strain, in order to establish whether there is a seasonal variation in any of the minerals. In the case of bracken this can be as high as 3% in summer, sinking to 0.11% in the dry fronds in the autumn as used for litter.

Four samples from those strains in the trial were used, and, as a control or standard, a sample of dried Symphytum officinale from Messrs. Heath & Heather. The cutting stage and date of this is entirely unknown. All that can be said about it is that it is what is sold by herbalists as "Symphytum folium", the dried leaves prescribed by orthodox medicine up to 1916 and used by some practitioners in the treatment of duodenal ulcers.

STEPHENSON BROAD. CUT MAY 5TH, 1954. HOLBROOK Y.F.C.

	%
Calcium expressed as Salt	2.35
Calcium Oxide	0.13
Phosphoric Acid	1.25
Potash	5.04
Iron (Fe)	0.253
Manganese (Mn) as parts per million ...	137
Cobalt	Faint traces

STEPHENSON NARROW. CUT OCTOBER 13TH, 1954. HOLBROOK Y.F.C.

	%
Calcium as Calcium Oxide	2.38
Total Phosphoric Acid	0.78
Potash K_2O	6.95
Manganese, parts per million	133
Iron (Fe)	0.144
Chlorides as Cl.	2.85
Silica	10.07
Cobalt	Less than 1 p.p.m.
Water Soluble Chloride	Present in large amounts

HOLMES STRAIN. CUT OCTOBER 13TH, 1954. HOLBROOK Y.F.C.

	%
Calcium as Calcium Oxide	2.77
Total Phosphoric Acid	0.75
Potash K_2O	7.09
Iron (Fe)	0.23
Silica	14.70
Chlorides as Cl.	2.72
Water Soluble Chloride	Present in large amounts
Cobalt	Less than 1 p.p.m.

WEBSTER STRAIN. CUT JULY 2ND. HOLBROOK Y.F.C.

	%
Calcium as Calcium Oxide	2.58
Phosphoric Acid	1.07
Potash K_2O	5.01
Iron (Fe)	0.457
Silica	15.54
Chlorides as Cl.	0.48
Manganese, parts per million	201
Cobalt	Faint traces

SYMPHYTUM OFFICINALE. SUPPLIED BY MESSRS. HEATH & HEATHER.

	%
Calcium as Calcium Oxide	1.31
Phosphoric Acid	0.72
Potash	3.09
Silica	9.48
Chlorides as Cl.	0.68
Iron (Fe)	0.098
Manganese, parts per million	85
Copper	Less than 1 p.p.m.

It can be said that calcium, phosphoric acid, iron, manganese and cobalt, the last even as faint traces, are assets to the nutritional value of the meal. The calcium is near that of lucerne meal, which has 2.78%, and the phosphoric acid considerably higher, about lucerne seed meal standard (1.34%), but no legume contains as much in hay or meal made from foliage. Parts of its value to the horse-breeder lies in the high calcium and phosphate, which appears to be in readily digestible form.

The extremely high potash is a handicap; it is rather less than twice that of 18% protein grass meal, which is 2.70%. In both cases the two commercial strains only are considered. The late cuts on the two non-agricultural strains—Holmes and Stephenson Narrow—are even higher, but both samples suffered from so much loss of nutriments that their ash content was unduly high; the rack-dried October 22nd cut from Mrs. Greer with 12.77% and Mr. Macdonald's oast house sample on November 3rd with 11.15% would probably show a composition approximately the same as those of the earlier samples. An excess of potash in the diet has a laxative effect on stock, but there is no record of this effect from feeding Comfrey either fresh or as hay. Nevertheless, it is a point to be considered by driers, though ample potash in

late cuts left to run to stem are an asset to those who grow the crop for compost. In the opinion of Dr. Horace Ward, who performed the analysis, the quantities of laxative minerals are no more than those eaten without harm by sheep and cattle in Scotland where seaweed is fed in quantity, or where seaweed meal makes a high proportion of the ration. Further work is required on both the ash and the trace elements; meanwhile, the best guide is normal farm practice.

Silage

The conservation of Comfrey as silage has been greatly handicapped by lack of understanding of the analysis. If the bulk of protein is to be preserved by lactic acid fermentation of the carbohydrates, either an outside source of these appears necessary or a by-passing of the difficulty of ensiling a crop with such a close ratio of protein to starches and sugars.

The simplest method was devised by Mr. J. W. Hobbs of the Great Glen Cattle Ranch, Fort William. He uses 25% Comfrey plus 75% of a cereal-legume mixture, in the oats at milky stage; the gain in protein has justified his 3-acre field of the crop. Excellent silage was made by the A.I.V. (employing added acids) process by Jealotts Hill Research Station, and the figure for this in the table below is quoted from "The Science and Practice of Conservation of Grass and Forage Crops" by Dr. Stephen J. Watson. In 1954, Messrs. Silorator Ltd. made pure Comfrey silage using their machines on their acre of first-year Webster strain. The moisture is given in the first column; the other nutriments are percentages of the dry matter, in all silage analysis figures.

	Moisture	*Protein*	*Oil*	*Carbo-hydrates*	*Fibre*	*Ash*
	%	%	%	%	%	%
Comfrey Silage A.I.V.	79.20	22.42	2.72	42.68	12.85	12.35
Comfrey Silage Silorator	82.52	18.40	3.90	41.40	23.70	12.60
Good Grass Silage (Bulletin 48)...	79.00	18.10	4.76	47.20	20.40	10.00
Good Maize Silage (Bulletin 48)...	81.05	8.65	4.32	78.60	40.60	7.60

Messrs. Silorator report that their silage, made without molasses, had a pH of 5.5; it was well fermented and palatable to cattle. An analysis by the North of Scotland Agricultural College of Mr. Hobb's mixed Comfrey and cereal-legume mixture silage, made by putting both crops through a chopper blower, showed pH 4.5, protein 14.37% and moisture 79.9%. The mixture minus Comfrey was 10.08% protein with 85.43% moisture, an improvement worth securing when the same relatively small Comfrey plot can provide the 25% for successive fields of the silage.

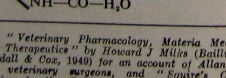
Further research on silage-making is highly desirable so that the summer production can provide winter fodder instead of coming at a time when there is plenty of keep. Unfortunately, it is not possible to make silage on a small scale, and cutting in bulk would have meant financial loss to the pig farmers in the trial. The exact degree of wilting to avoid excess moisture in the product, the quantity of molasses needed to hold the protein, the use of milk by-product Lactic acid, and whether 25% is the ideal proportion to mix with an arable silage mixture, need to be established by research that involves too much labour to be done as voluntary "spare time" experiments. It is hoped that in time the Association will be able to explore this unknown field.

Allantoin Analysis

The Comfreys contain diureide of glyoxylic acid, known as Allantoin, which is a cell proliferant, increasing the speed of healing of cuts and internal irritations. If none are present it passes harmlessly through the system, a fact known by tradition to many hundreds of pig farmers. It is also of value in the case of bone injury, and was isolated by Robinson in 1935 in the excretions of maggots in plaster-cased fractures, especially where osteomyelitis had delayed recovery, explaining the successes in defiance of hospital hygiene, in the Spanish Civil War.[12]

The measurement of the exact quantities of this substance in the strains, and the influence of drying methods and cutting stage on the quantity present in any sample, is of importance before any serious work can be done on this substance to discover its uses and limitations in veterinary surgery or medicine. Unfortunately, herbalists do not analyse their products, so dosage is variable, though the early herbalists with their complex directions for gathering evidently recognised that quantities of the desired medicinal principles varied with the season.

It is not possible to determine the percentage of Allantoin in any sample of Comfrey by the methods of the feeding-stuffs analyst. The formula of the substance is:—



12 *See "Veterinary Pharmacology, Materia Medica and Therapeutics" by Howard J Milks (Bailliere, Tindall & Cox, 1949) for an account of Allantoin for veterinary surgeons, and "Squire's Companion to the British Pharmacopœdia" (1916) for a medical account.*

The ash analysis cannot reveal something which breaks up into gases in heat, and there is a risk that a commercial grass drier would destroy this valuable substance which offers a pig or calf meal that prevents or cures scour.

Dr. Horace Ward is working on methods of determining the percentage of Allantoin, modifying the system used by veterinary surgeons to test the urine of cattle in certain clinical conditions when the substance is present. I wish to thank Messrs. Burroughs Wellcome & Co. and the Physiology Department of the University of St. Andrews, Fife, for suggesting possible lines of research. Once the method is discovered a full reserve set of samples from the trial will be tested, and there will be no more difficulty than testing for carotene so far as the drier selling to a compounder is concerned.

In the next section we give the experiences of working farmers on this substance, but it should be clearly understood that until research has been carried out by qualified workers in the veterinary and medical field there is no knowledge of how far (if at all) it is an improvement on existing treatments. Free preventative medicine in quantities that can do no harm as a by-product of a crop that already pays to feed is of real value, even though its use as a specific medicine, not a feedingstuff, may not be established by the experiments of the future.

Our next report will contain a full set of Allantoin analysis figures. These will be available earlier to any doctor or veterinary surgeon who can make use of them in research.

5. FEEDING RUSSIAN COMFREY

The most profitable stock to feed with Comfrey in Britain today is the pig, and pig feeding pays even with yields at the 30-ton standard, when over 85% of the production cost is meal. The wide ratio of protein to fibre fits it to the digestion of the pig, and their great appetite for it makes it highly suitable for a modern version of the Lehmann feeding system, without the troubles from excess fibre in the lucerne fed usually in this method. It should not be compared with fodder beet, which contains about four times as much carbohydrate, one-third of the protein and slightly less fibre. The root crop is very much higher in labour cost than green Comfrey after the first year. One is a carbohydrate feed, the other protein, and the fat caused by a high carbohydrate diet becomes more and more unpopular.

The biggest liveweight gain from vegetable protein *ad lib.* comes in the early stages, and small weaners level up fast. Feed all they will clear up and half normal meal, which means that porkers coming on for 8 score will take 10–15 lb. a day of fresh-cut Comfrey, though they start at 3-4 lb. No pig feeder in the trial weighs the quantity he cuts per pig; the procedure is to take a daily cut, near the piggery or pig pasture, and throw it in to them. No wilting is necessary. The moisture, roughly the same as that of a mangold, merely means that they drink a bit less compared with their needs on a dry meal diet. The meal fed is normal fully balanced compounds, or pig nuts, but, with serious nutritional research, a cheaper balancer to supply concentrated carbohydrate and the animal protein factor could be devised. With baconers there comes a stage, usually about 130 lb. liveweight, when carbohydrate needs increase, and the meal proportion should go up by as much as a pound a day, finishing at about three-quarters normal; if growth slows, after a good start, step up the meal a bit. The yardstick is profit per pig, not maximum liveweight increase in the minimum period, and small stores bought cheaply, so long as they are healthy, mean the most return for the small man on this system.

This summer the question of quality as reflected in price was difficult to determine. Mrs. Greer's pigs, as an example, caught the one week after restrictions were removed and prices up, and Mr. Stephenson's batch, reached the market at the lowest. Unfortunately, in the trial as yet we have no really large-scale pig farmer working out his costs in decimals of a penny per score and weighing a large number of pigs weekly as a matter of routine to provide a really accurate comparison.

Mr. E. V. Stephenson bought a batch of seven Essex stores at eight weeks old, aiming to have them come to maximum Comfrey needs when the mares had left the stud, and to carry out weekly weighings. This first experiment was ruined by slow delivery of the weigher, so only the last weeks of the trial could be recorded. At 16 weeks old the pigs were on 2 lb. of meal per head per day, plus 9 lb. Comfrey; the quantity went up to 10 lb. a day for the 19th, 20th and 21st weeks, still on 2 lb. meal.

WEIGHT INCREASE TABLE

20th	*21st*	*22nd*
115	117	125
107	113	116
103	106	112
102	105	110
97	102	106
97	100	100
97	100	104

The trial could not be completed owing to a shortage of Comfrey from the cold season. Mr. Stephenson planned ahead with the experience of years and estimated that he could put a batch of pigs through as a trial, without interfering with the needs of his horses, out of his normal

summer surplus. The aim was to see how little bought meal would bring a cheap batch of weaners, all on the small side, to pork. After the 22nd week (ending September 17th, 1954), the Comfrey had to be cut down to 3 lb. a day and the meal stepped up, but Mr. Stephenson considers that, with his saving on meal from the start, his were the only pigs that left a profit at the prices ruling on the day of sale. Next year, with a chance of better weather, he will try again; this season he had to take a decision on whether to feed his Comfrey to pigs making a bad price, or use it for horses that were paying, and his choice was that of a farmer rather than that of an agricultural research worker, for, like everyone concerned with this trial, he had his living to earn. It is interesting to note that at these weights the recommended allowance on the Lehmann system is 3 lb. per head meal per day, which may or may not be better, and that considering meal only the conversion ratio is 3½ to 1. Though such a trial can hardly be regarded seriously by Research Stations concerned with animal nutrition, it is certainly of value, if only historically, as the first-ever to be attempted with a known Comfrey grown by modern methods.

The traditional use for Comfrey is as a scour preventative in pigs, and it is still in use casually on some farms where there is no knowledge of it other than tradition. The modern system is to feed 5–7 lb. fresh to the in-pig sow, not altering her diet greatly, or taking only a small meal saving; her mineral needs are high at this time and she likes the feed. The ration is continued and increased after farrowing, giving plenty of young growth. A sow will eat Comfrey at any stage, but very small piglets turn to fresh Comfrey as a first solid food. The gain is in a slightly reduced demand on her milk and, with a big litter, the runts, nisgards or wrecklings (the term varies for the small pig in the litter) get a better share of the teat room when their bigger competitors are eating Comfrey. The result is a more level batch and a quick early liveweight gain from suitable vegetable protein, with the minimum fibre supplementing the sow's milk.

One Essex pig-keeper (address on application to research workers) has, over many years, cashed this aspect by aiming at an average of 18 per litter, by selecting his sows for litter size and serving at the extreme end of the period; he sells as weaners and more to the farrowing pays well, when all make a good price as a level batch.

The second advantage is the removal of the risk of scouring at 10 days old and at periods when the sow's milk alters in richness, or there is any change of diet. It seems also effective against scours caused by Bacillus coli. The Comfrey ration to the sow herself prevents after-farrowing scour, and the use of Comfrey hay in winter for sows has justified its making many times on this account. Mr. Macdonald made some in his oast house in 1953, by cold blowing on cowl and fans before hop drying in a better summer (21% protein, 11% fibre, about average for the method), and cured a sow with a bad attack of after-farrowing scour in January. He fed 6 lb. of the dry hay daily plus water only, as a sole diet, for three days and cleared up the trouble. Pigs of all ages will take Comfrey hay with greed, or it can be hammer-milled as meal and fed with suitable balancing feeds, but so little has been made that little knowledge of the winter diet contribution is available. So much rests on merely practical experience, with nothing weighed or recorded, but from the consistently successful treatments of scouring spread over the past hundred years, and the feeding advantages that have produced good results on the farm over the same period, that we can be more certain of its value for pigs under modern conditions than for any farm stock.

Another traditional field where modern experience supports the past is in horses; today, not the working animals of the 1870's, but racehorses, stud stallions, riding school hacks, hunters and show jumpers. In 1953 Mr. E. V. Stephenson set out to repeat the experiment of the Rev. E. Highton of Bude in 1875,[13] who fed Comfrey *ad lib.* instead of hay, and halved the oat ration to the horse, which was the then equivalent of a small car. He fed Tom Atom, a four-year-old gelding used as a trainer's hack and hunter, on 4 lb. oats plus 40 lb. fresh Comfrey a day, the amount an adult horse will clear up easily. Tom Atom kept in splendid condition; he managed two days a week cubbing and, finally, on the late cuts that continued into December, a day a week with the Holderness, apart from his normal work.

The saving on hay, including the extra labour cost, amounted to 17s. 6d. a week in 1953, and the beast was harder worked than he could have been on grass alone, and in better condition. The higher starch content means that horses on grass run to fat, and one is not feeding for liveweight gain or milk yield, but energy and speed. In 1954, the experiment was repeated with Woodcote, a stallion valued at 5,000 guineas, with the same success. Horses and show jumpers in training received the traditional allowance of 4 lb. per day, which keeps their dung in the condition known as "right" and supplies mineral and Vitamin A needs, the "green meat" in the diet for which lucerne sells in Newmarket at about 6d. a bunch in season.

13 *Journal of the R.A.S.E., Vol.* 18, 1882.

The ration is a normal part of the diet and in no way increases the speed of a horse; it may, by removing the risk of some digestive disorders, make him less likely to be "scratched", but speed is in the breeding, skill of the jockey, and many other factors. Neither Tom Atom's successes as a steeplechaser (he was sold for this purpose after the trial) nor Rowston Manor's failure to win the Derby in 1954 can be attributed in any way to their Comfrey rations.

Mares and foals in the spring receive approximately 14 lb. a day, the quantity that long experience shows removes any risk of scouring. The value of the animals concerned averages £100,000 per season, apart from the stallions, which are given about the same ration at this time of year. In the spring no question of money-saving arises; the need is to give expensive horses the best and to insure against trouble. Both the Allantoin and the minerals are of real value at this stage.

The summer production is used to reduce costs, and the costs of all concerned in horse-racing (except bookmakers) need as much attention as those of the normal farmer. Stallions are stall-fed, the paddocks used for exercise only, and their owners and those of riding schools, with fields packed with beasts by standards of the grassland dairy farmer, all expect to buy hay in summer. This hay needs qualities which are measured by smell and feel rather than analysis; it must have started as good quality and then matured in the stack, with certain changes (including a rise in minerals from the fall in other substances) that justify very high prices. The 1954 season is going to leave very little hay of any quality to meet the needs of riding- or race-horses; what there is will be very expensive.

Fresh Comfrey, it seems, acts as a balancer for a lower-grade hay, or a substitute for the normal expensive type used by trainers and breeders within certain limits. In training, concentrated foods are required, but for maintenance and normal work the Comfrey allowance can be increased. Concentrates produce the effect known for perhaps 600 years as "feeling their oats", ample green food the reverse. It was the process of increasing the ration of Anatom to secure this effect in a good sire, but bad tempered at times, that showed the way to the cost saving, though good condition plus a milder temperament is also of value to riding schools. It can be said that 90% of horses take to Comfrey at once; the others take a bit of coaxing but like it when they are used to it. The method is to chaff it and feed with other foods until they learn the unfamiliar taste.

The knowledge available on horses is purely from the accident that the most experienced grower is a stud farmer; the death of Mr. Kenneth Crawley of Lockabie, who grew about 4½ acres and fed it extensively to his dairy herd, prevents a similar account of feeding to cattle. The loss of his milk yield records made in the 1940's when he was feeding 56 lb. a day per beast, cannot be replaced until there are farmers in the trial who can undertake the work.

The traditional use is as a calf feed in spring, and as an insurance against fodder shortage in late summer and autumn, when it was cut and carted to bare pastures. The many silage-making failures and the rise of marrowstem kale are the main reasons for its loss of popularity, and until the conservation difficulties have been overcome and serious nutritional research has been undertaken, all we can say at present is that on the existing evidence it is rather less likely to be of value to the dairy herd than to any other farm activity.

In other countries the picture alters. A high protein feed in production through a major part of the dry season, in a climate where all native fodder runs to fibre and suffers a far quicker fall in carotene, is of value, especially where concentrates are not only costly at railhead, but increased still further by transport charges for a long journey over bad roads. In Africa the crop is fed as a concentrate; that is, as the high protein to give milk yield on top of the available fodder which supplies starch equivalent mainly as digestible fibre. It is used chaffed at first, until the cattle get used to it, and can then be fed fresh. Though in England it has been fed wilted until dairy cattle learn to like it, in Africa it is hardly possible to cut fodder without it being wilted when the beasts get to it. The best cutting stage is the "fountain of leaves" before the stems form. In England a good leaf is 2 ft. to 2 ft. 6 in. long and half that wide, and even larger leaves have been grown in Africa.

No milk yields are yet available from Africa or any other overseas country, but it is hoped to include some in our next Report. All that can be said is that farmers feed it and like it, and the better they grow the crop the better the yield and the profit. Where it grows a heavy weight of high protein fodder at a time of year when this is of real value, not an addition to an existing surplus, the economics of cultivation are altered and it is possible that in England with self-feed silage and kale, plus good leys, giving minimum milk production costs, it may not pay; yet in other countries with a longer growing season, despite less regular rainfall, it can be highly profitable. It should be noted that in Africa it is fed with knowledge of its qualities; no attempt is made to use it as a sole diet for cattle, which means a fall in milk yield, perhaps one of the reasons for the failures in early nutrition trials.

The traditional calf-rearing methods have been retested by Miss Arundel, Col. Bence-Jones and Mr. Macdonald. They are to start feeding fresh Comfrey when the calves are at bucket stage, about 2–6 lb. a day according to size. The object is to secure the same advantages gained by pig breeders —the loss of the scouring risk and extra protein that is both cheap and available over a long period. The term "scour" is a loose one and, though in the opinion of calf-feeders White Scour should be included, veterinary research is desirable.

Messrs. Silorator Ltd., on their Hertfordshire farm, tried the experiment of folding bullocks behind an electric fence on their first-year Comfrey plot. As only an acre was concerned, all that can be said is that the beasts grazed it as though it were kale, with evident enjoyment. The method has been used for goats, but the stock must have some other grazing as well. Until it is possible to work out the economics in terms of liveweight increase or milk yield, and the effect on the plot of grazing it like a series of kale crops (in view of the possibility of treading the crowns), the most that can be said of folding stock on Comfrey is that it has been done successfully. Grazing Comfrey with pigs is not possible; an account will be found in the Appendix on "Methods of Destruction".

With goats, the same principles as feeding to cattle apply, except that the starch equivalent can come from rougher material. It has the advantage over marrowstem kale that the leaves tilt clear of water, and goat-keepers with experience of cutting kale will realise that this is a real merit in wet weather. Mrs. Greer has fed it to her goats with success; many other goat-keepers use it, including the Anglo-Nubian breeder who swept the board for this breed at the 1954 Dairy Show, but, as is usual with goats, no figures are available. No information is available on feeding Comfrey to sheep, though, from the past and from the late Mr. Kenneth Crawley, we know that when they are used to it they eat it readily.

Poultry share with pigs the advantage of a bonus on the low ratio of protein to fibre, but in this Report they suffer with the goat and the cow from the absence of recorded experiment. The normal procedure is to use the fresh crop like any other green food, with the advantage that it can be cut in great bulk from a small area over a longer season than any brassica. It can also stay in the same place, handy for cutting, and is entirely immune from clubroot.

Mrs. Greer feeds it to deep litter birds, so does Mr. Stephenson, and he has a working arrangement with a neighbour, exchanging summer Comfrey for winter thousand-head kale. Most of the other farmers feed some to poultry, and there is ample evidence that it will replace other green food with advantage. Col. G. W. R. Monckton, the well-known Australorp breeder, has fed fresh Comfrey to his deep litter birds by tying it up in a hay net for them to peck at. On several occasions he has fed fresh short grass mowings and Comfrey on the litter to give perfectly free choice, and the grass is never eaten until the Comfrey is gone. The growers who feed Comfrey in quantity consider that there is a meal saving. Mr. E. V. Stephenson, who mixed it chaffed with a battery mash during the war, considers the saving as high as an ounce a head per week, but any saving must be considered in relation to egg yield.

It is hoped to carry out tests at Bocking to determine at what stage the saving of meal (if any), by feeding Comfrey, balances the fall in egg yield from increased bulk or low carbohydrate, and if the liveweight gain from vegetable protein in the early stages can be an advantage in the production of table poultry at "broiler" stage. Any tests will be on a small scale and will suffer from the risk of inaccuracy from a single trial, so the co-operation of a few large poultry farmers would be highly desirable even if no help can be given by Research Stations or Farm Institutes concerned with poultry nutrition.

It was established in the Harper Adams Trials that 2½ oz. per day of fresh grass mowings, to provide 10% of the dry matter in the mash, produced delayed maturity for young birds and a 50% drop in egg yield. The problem is that excess fibre in the diet prevents the digestion of the carbohydrates in fowls. The question is: Does reducing the fibre in the green food by half or two-thirds still produce the same effect, and at what stage the fall in weight gain or egg yield begin? In other words, how far *exactly* can cheap Comfrey replace expensive meal before the production falls?

The experiment has never been attempted and, in view of the tight squeeze between feed prices and the price of eggs and table birds, it is going to pay to find out.

Another unknown field where we hope to gather firm knowledge is that of feeding Comfrey meal to poultry. The proportion of grass meal recommended in a laying mash, when feedingstuffs were rationed, was 10%. If the fibre is halved, can the proportion go up to 20%, or to what greater or lesser figure can we add home-produced Comfrey meal at a profit? Grass meal today is relatively expensive for the poultry farmer in terms of feed value, but it is certain that using the roof-top method, with even 1954 weather and a tractor mounted or other hammer-mill, he can produce a considerable tonnage on his existing buildings if these are suitable. The question is: How far will it pay him to use this meal compared with other home-produced or purchased meals?

At the present stage we do not know, and calculations or quotations from past experience of other varieties grown by other methods cannot help; the answer can only be found out by experiment on a relatively inexpensive scale, but involving accurate recording and absence of prejudice either for or against this crop.

During 1954 it has been discovered that the system of weeding by poultry described by myself in "Russian Comfrey" is not practicable. It worked well on Mr. E. V. Stephenson's ¼-acre plot, where the crop was grown stemmily on fewer cuts for horse feeding. Semi-intensive poultry were allowed to use the plot as a run (and still are), pecking up weeds and eating the plants only near the house entrance, or the odd leaves left after a cut when these had wilted. This gave cheap weeding with about 150 layers kept purely for this purpose.

Col. P. Bence-Jones, using the same Comfrey strain, cut more frequently for calves, found that his hens ate the crop to the ground, and the same experience was reported by seven other growers. The answer appears to be that young Comfrey, well grown and at its most nutritious stage, is eaten readily by stock, including poultry, and that those who consider it unpalatable have merely grown a poor sample in terms of the stock to which it is fed. It should, therefore, be said that it is not safe to count on anything *not* eating Comfrey, though in areas where there was no myxamatosis no cases were reported of rabbits eating the growing crop. This is not necessarily evidence in Australia.

Mrs. M. Ridsdale, whose poultry farm is near Salisbury, Southern Rhodesia, also tried weeding with six-weeks-old birds, and they pecked the crop to the ground in a day, and the paddock has now no plants at all; every particle of leaf was taken as soon as it appeared, until the roots died. Her normal practice is to feed by cutting and tossing over the wire, and she is expanding her plantings in resting paddocks that have been heavily dunged by the birds. At present it is not possible for her to carry out feeding trials; the need in her circumstances is green food for a very large flock for ten months of the year, which nothing else can supply so easily.

Mrs. Greer discovered that both geese and ducks would graze Comfrey, though they go for the leaf and ignore the midribs if they are only on for a short period. Both birds graze for protein; geese will nip the growing points and young foliage out of a pasture rather than clear the roughage. Grazing successive areas behind netting or electric fencing (now possible by an ingenious application of the principle that beaks and claws are uninsulated, even though feathers are shockproof) may be an economical way of feeding, with a suitable balancer meal fed at the same time. The beak shape of ducks and geese, and the absence of scratching claws to clear a crown for the final pecks, may make this discovery of future value in Britain and overseas.

Another nutritional application is that of human food. Comfrey was cooked like spinach and eaten by many of the growers in the trial, and the rather Mrs. Beaton-like Victorian recipes in "Russian Comfrey" were also used. As a market vegetable, its swift wilting prevents any wide sale in this country, though, apart from any medicinal qualities that may be established by research, it is of use in emergencies. Overseas, with long periods when no green vegetables are available, and in countries like India where only a quarter of the need for vegetable protein is contained in the average peasant diet, it has greater value. The digestion of the pig and that of a human being have many affinities; neither of us can digest fibre in any bulk.

A grower in Ceylon is going to try to discover methods of cooking which suit the vegetarian races of that Dominion, and it is hoped that a full exploration of the place of this crop for direct human food can be made during the next five years. It will not be a complete diet, and it would be extremely boring if it were, but as a source of cheap vegetable protein, either fresh or dried as meal, suitable for tropical and sub-tropical countries, it deserves serious attention.

6. THE PROGRAMME OF THE HENRY DOUBLEDAY RESEARCH ASSOCIATION

Our main objective is to continue the present trials by growers in Britain and abroad, pooling results and passing on the information gathered by experience to all who need it. The present report is mainly written to give every grower the very latest news of the progress of his colleagues in the informal group who are giving their time and trouble to research for mutual benefit. What began as a one-man, unpaid advisory service in 1952 has extended so greatly that its formation into an Association, capable at least of paying its own postages and its stationery, is now necessary. Within the limits of our resources, we offer our help and advice without charge to those who grow or wish to grow Comfrey in any part of the world. We also offer our co-operation and every facility we can for the checking of our results and the accurate design of experiments to repeat those described in this Report, to those officially concerned with food production in all countries.

The small trial ground at Bocking will have two major tasks, apart from any secondary experiments on conservation and feeding. Neither of these has ever been attempted in the history of the crop; no

farm has the facilities and no nurseryman the foresight to undertake either.

The Production of Improved Varieties of Comfrey

The work of Professor K. V. Braid at the West of Scotland Agricultural College, and Dr. P. J. Watson of the Scottish Plant Breeding Station, has established that the plant botanically described as Symphytum peregrinum is correctly a hybrid. Its name should be "*X* S. Uplandicum", but it is not proposed to add this additional name to the problems of the crop. The parents are Symphytum asperum and S. officinale, both of which have 36 Chromosomes like their more productive offspring. S. tuberosum, the Tuberous Comfrey with large black roots rather like those of a dahlia, and entirely different flowers and foliage, has 72; it does not, therefore, interbreed and is of no agricultural or medicinal value, though it is sometimes tested by Research Stations as "Comfrey" where the botanical investigation of the crop has not included John Gerard's "Herbal" (1597) or any later work on the British flora.

The original cross was probably a natural hybridisation that took place in the collection of Symphytums gathered by Joseph Busch, the Hackney landscape gardener who laid out the grounds of St. Petersburg Palace for Catherine II ("the Great") of Russia. Plants were sent from there from 1870 onwards (other Symphytums were sent earlier, the first in 1790), and the latest import is reputed to be in 1900. Since Henry Doubleday selected the solid-stemmed "Russian Comfrey", so called to distinguish it from the parent species, S. asperum, the Prickly Comfrey, which was already widely grown and exported to the Continent by James Grant, the plant has had a confused genetical history.

The original hybrid was sterile, or semi-sterile; the stamens are shut off by a kind of "false bottom" in the flower which is, by a freak that may occur perhaps once in every 100,000 flowers, sometimes available for bees to transfer as far as it will go among the neighbouring blooms. The pistels are, however, always open to receive pollen from our native Common Comfrey (also found in Europe, including Russia), both the cream- or white-coloured true S. officinale and the purple-flowered S. officinale var. patens. Seed, which takes three years after sowing to reach the size of a normal planting offset, therefore produces widely varied offspring, because it is either that of a self-pollinated hybrid or the backcross of a hybrid with its least productive parent.

Any surviving Comfrey patch will include the results of seeding in the past (the plant has no seed dispersal mechanism, they fall around the parents or are thrown a short distance as a 4-ft. specimen sways in the wind), either from self-pollination or cross-fertilisation, and will show a wide range of variation. It also, because though the roots die out, others grow from the younger portions, contains specimens that have increased vegetatively.

This has created problems of identification and it is extremely hard to say exactly to which species a Comfrey belongs; all that one can do is decide which plays the greatest part in its visible make-up. This difficulty has as little relevance to the farmers as a discussion as to whether Arran Pilot is the *true* Solanum tuberosum or Aberystwyth Cocksfoot S.26, genuine Dactylis glomerata or a sub-species. It is only discussed here to make it clear that the crop is a "cultivar" or cultivated plant, like all others grown on the farm, and to explain to growers especially overseas why this plant cannot be increased from seed, because of the handicap of its flower structure and genetics.

The two main commercial strains are both collections of variations, and it should be said that any really determined botanist could split almost any crop raised into a host of sub-species and varieties. The seedsman breeds for the qualities that are required and "rogues" out those untrue to type, ignoring fine shades of variation that do not make any difference on the farm.

Their qualities are an average and, as both are propagated by division or root cuttings, they remain constant. So far as can be seen by eye, the Webster strain, from the 1900 import, has the fewest variations, and the Stephenson includes these with some additions collected by the late Mr. Kenneth Crawley. Whether these are better or worse, or whether the 1900 import was better than anything that may survive in Ireland in an area without wild S. officinale, like the strain discovered by Col. Bence-Jones, is unknown. The results in this trial were secured with these strains as sold today; until more accurate knowledge is available they cannot be improved on; and those who buy Comfrey should insist on one or other strain or a certified yield and analysis record of whatever is being sold. Every revival of interest in Comfrey since 1810 has found nurserymen and others sufficiently dishonest to dig wild species from the hedgerows, or collect the untested mongrels that may be found as weeds where the crop was formerly grown.

Our first objective is to provide the evidence on which the crop can be rogued, by testing variations presented by many nurserymen and farmers under identical conditions. It is hoped to put down a large number of one-fortieth-acre plots, to be tested for analysis, including ash, palatability to stock of several classes, ease of conservation (there may be "hay strains", "pig and poultry strains" or "horse and cattle strains"), carotene, and finally yield.

As yield can only be tested over a four-year period and involves a large number of replicated trial plots, this will have to wait until both stocks and financial resources are far greater. The knowledge gained will enable growers to rogue or sort their stock, because all the variations we have are in the existing strains.

Our second is the testing of a large number of suitable legumes to sow under the crop, using a standard commercial Comfrey. The objects are twofold: the first is to find a legume which will suppress grass during the three-year period when weeding is a problem, and to reduce both labour cost and the need for nitrogen as manure. It is likely that the legume will be killed out completely under established Comfrey, apart from clover sickness if this affects the most suitable undercrop.

The second objective is to reduce the high cost of planting large areas from offsets. The cost of their production makes them compare with bush fruits rather than fodder crops; £17 10s. per thousand is a large investment, even though its cost can be spread over twenty years. Before 20-acre fields can be planted the cost must come down, and we, therefore, propose to start long-term research which may bear fruit by the time (and if) plantings on this scale are justified.

The crop will grow from very small fragments of root which could be sown along a drill like seed potatoes, and their cost would be low because of the greatly reduced time and labour required to produce them, for an offset takes a year to reach planting size from a root cutting. This was frequently tried in the past but failed, and Messrs. Sutton's Farm Seeds Catalogue for 1878 warns against the use of these fragments (they sold a Comfrey from 1875 to 1896). The roots grow slowly and become strangled with grass and weeds, with many gaps, and offset planting is the only method of securing a good crop, both then and now.

The legume trial will include half its area under cut roots, with standard offsets on the other half. If the growth of the legume is sufficient to keep down grass, with probably thicker sowing than normal, it may be possible to start a field of Comfrey cheaply by taking, say, clover hay or seed, even grazing in the first year, with the permanent crop coming through during the summer, and going into production the following spring. The profitability of this method, the correct legume, or even if it is possible at all, can only be found out by experiment. Any legume suitable for Britain would only be of limited value in the tropics, and the experiment would have to be repeated in each climate. In countries where nitrogenous manure is short, and intensive pig-keeping impossible on religious grounds (as an example, among Mohammedans), this system might be of great value.

The donations we receive, both as money and plants, are given to support serious research on this crop for the benefit of growers, and it is, therefore, spent on attempts to solve problems which cannot be attempted by the methods which have so far produced so much useful information for such relatively small sums. All that we can do by voluntary work we shall; money will be used only for postage, the sampling and payment of analysis fees and other methods of measuring the results secured by enthusiastic amateurs. This crop is unique perhaps in the enthusiasm it can command in all countries, among those who have seen it grown well, in contrast to those who have merely read and condemned.

How far we shall get with this programme depends on finance, and the more complex the questions which we ask Nature one at a time, the more expensive are definite answers that can be measured and recorded. Unlike the manufacturer of synthetic foodstuffs or the cultivation of algæ in tanks, this research offers no attractive prospects of a vast market for the products of the heavy engineering or chemical industries; it has no fibre for textiles and no conceivable possibility that it can be used for destruction or defence.

From the evidence gathered by eighteen men and women who know and grow this and myself, it seems highly probable that we have here a plant that could help the farmers, the smallholders and the peasants of Britain, and many other countries where the need is greater, to feed more people from fewer acres. We may be wrong, or only partly right in some parts of the world, but it will take about as much as was spent for one day's advertising of chlorophyll as a deodorant, during the booming of this substance, to find out what we need to know about these great green leaves, and whether we can harness their speed and power for the benefit of all mankind.

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Fig. 9

"No stock will eat it," say those who have merely looked this crop up in a book. Bullocks have been folded behind an electric fence like marrowstem kale. This cow on Mr. I. G. Macdonald's farm, grabbed it from Lawrence D. Hills rather too fast for the camera.

APPENDIX

The Destruction of Unwanted Comfrey

It should be said that no farmer in this trial, or any other farmer who is growing good Comfrey well, wants to destroy Comfrey. Because the roots are stronger and harder to kill than those of other crops, like those of a horse-radish, and killing methods are little known, these are given here. It is hoped that they will be used on many mongrel survivors in hedgerows and pastures, good commercial strains are too valuable to destroy and are better sold to those who know how to grow the crop.

The surest and easiest method is to wait until the plants can be seen easily in spring, or at any time before they go dormant, and drive a spade through the main root as though propagating as advised in Section 2, but just below the surface; the aim is to expose the white root centres where these are gathered together below the crown. Throw the tops into the pigs, or leave them to wilt until they can be burnt. On each cut surface put about a teaspoonful of Sodium Chlorate, and then merely leave this to rot the whole root system exactly as though you were killing a tree stump. Because the root system is large, the weed-killer is greatly diluted and, after three months or so, the land can be cropped normally. This is cheaper and far more effective than just scattering Sodium Chlorate on the plants.

The method is recommended for all small plots, for monsters from the past on headlands, and especially for overseas research plots where the crop is a proved failure from climatic or other reasons. It may sound costly in labour on a large scale, but it is far cheaper than ploughing, cultivating, harrowing and hoeing until the roots are spread all around the farm. With a good strain it is possible to cut at propagation level, 3–4 inches, lift the crowns for sale or replanting, and then kill the remains of the roots in this way, so the next different crop grows perfectly clean.

The system used by the German peasants, who kill their plots after transplanting offsets (they leave these down ten years only), is to fold pigs on the crop. This is the best farm system. Put on the pigs about May, when the growth is high, using them unrung and cutting down their nuts until they root well. Use either tethers or an electric fence and keep them on the plot all the summer, or give them a series of spells on it; they will not only get out the roots they can see, but they will eat the scakale-like attempts of the plants to struggle through, which they detect by scent. There have been many cases of attempts at pig folding, and all have ended in the destruction of the crop. Ploughing may secure a quicker result when the surface and crowns have been cleared. The pig is the best way of getting rid of unwanted roots when cutting up for propagation; their delight in Comfrey roots is too expensive a taste to gratify at other times. Tethering a boar or dry sows is recommended for getting rid of hedge Comfrey, and sowing to a chicory and clover ley for pig grazing the best way out for an infested field.

No arable crop should ever follow Comfrey; potatoes are the worst, as the ridging and earthing breaks the roots and spreads them. After Mr. Kenneth Crawley's death, 4½ acres of his crop was killed in the following way. Plough in January, taking off the crowns as though they were mangolds for pig feed, then sow to a five-year ley. The land was left rough for the frost to get at the roots, which is harmful at this season. December and January in hard weather give some kill by ploughing; in other months this just spreads the plants. Then the ley was grazed with sheep, and now it is clear of Comfrey. The strangling of the grass and the close biting of the sheep removed the crop in two years.

Close grazing is the best way to remove starved Comfrey from grass land. Tether a bull, goats or a donkey on any plot and it will be destroyed in a couple of seasons; a single season if the plants are poor. If milking goats are used, unless there is other grazing they must be fed, the starch equivalent balance goes down if they are killing out waist-high Comfrey as a sole diet. Donkeys manage perfectly, but they want to stay on long enough to bite the crowns right down repeatedly through the summer.

Sodium chlorate is best, pigs cheapest but not so quick, ley sowing and grazing longest, and tethering most trouble but useful for small and obstinate patches. Selective weed-killers have been tried and double-grain crop strength 2–4–D applied three times at intervals of a fortnight is reputed to kill the plant. One experiment has been tried with Tecane; it killed the grass and left the Comfrey. At Bocking, trials of selective weed-killers will be made to discover if the crop can be both cleaned and destroyed by these chemicals, if finance permits, but there are many more urgent problems. If a plot has deteriorated so far that it cannot be cultivated by machine, and yet the strain is good, then either transplant to a new site and kill the old by sodium chlorate or pigs, or dung well to get growth ahead of the weeds and mow repeatedly, using the fallen foliage as a weed-killing mulch. Then clean by hand hoeing until the crop is strong enough to suppress its weeds. Many perennial weeds will not stand up to monthly cutting. Comfrey is srengthened by it, and this is effective with bracken, thistles and nettles, but not unfortunately couch grass, creeping buttercup and normal pasture grasses.

The cheapest method of dealing with Comfrey, like any other crop on the farm, is to learn how to grow it well. After all, an orchard neglected for twenty years by a man who did not know anything about fruit would be quite expensive to remove and replace with arable crops.

MEMORANDUM OF QUAKER COMFREY SHIPPING TIME

Quaker Comfrey is distributed twice a year, in the spring and in the fall. This means spring or fall, in our area, in Canada. (a) Spring distribution, between May 1st and June 15th. (b) Fall distribution, between September 1st and October 15th.

Because harvesting Quaker Comfrey depends on weather conditions — a rain-free period — this wide gap of shipping dates has to be made. Growers will be informed ten (10) days ahead of definite shipping date. Planting instructions will be sent with shipping date announcement.

Free bulletins on Quaker Comfrey and all other information about Quaker Comfrey will be gladly supplied on request.

Yours very respectfully,

BODIE SEEDS, LIMITED.